<36614380100013

<36614380100013

THE

RAY SOCIETY

INSTITUTED MDCCCXLIV

LONDON

MDCCCLII.

A

MONOGRAPH

OF THE

BRITISH NUDIBRANCHIATE MOLLUSCA:

WITH

Figures of all the Species.

BY

JOSHUA ALDER AND ALBANY HANCOCK.

PART VI.

LONDON:
PRINTED FOR THE RAY SOCIETY.
MDCCCLII.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

J. E. ADLARD, PRINTER, BARTHOLOMEW CLOSE.

A. Hancock del. W. Wing lith.

Ford & West Imp.

DORIS TUBERCULATA.

DORIS TUBERCULATA, Cuvier.

D. elliptica, subdepressa, flava vel auriantiaca, fusco griceove sæpè liturata; pallio tuberculis depressis, crebris, inæqualibus; branchiis 9 tripinnatis, effusis, intra foramen retractilibus: tentaculis labialibus tubercularibus.

Doris tuberculata, Cuv., in Ann. du Mus., v. 4, p. 469, pl. 74, f. 5.
Lam., Anim. s. Vert., 2d ed. v. 7, p. 463.
Johns, in Ann. Nat. Hist., v. 1, p. 50, pl. 2, f. 1, 2.
Macg., Moll. Anim. Aberd., p. 197.
For. and Hanl., Brit. Moll., v. 3, p. 563.
argo, Penn., Brit. Zool., v. 4, p. 43, pl. 22, f. 22.
Turt., Brit. Faun., p. 133.
Grant, in Edinb. Ph. Journ., v. 13, p. 198.
Flem., Brit. Anim., p. 282.
Dalyell, Pow. of Creat., v. 2, p. 294, pl. 42, f. 4—7.
argus, Stark, Elem. Nat. Hist., v. 2, p. 68.
Bouch. Chant. Catal. des Moll. du Boul., p. 40?
pseudo argus, Rapp, in Nova Acta Acad. Nat. Cur., v. 13, p. 519.
Bouch. Chant., Catal. des Moll. du Boul., p. 41.
Britannica, Leach, Syn. Moll. Gr. Brit., p. 19.
Montagui, Ibid., Syn. Moll. Gr. Brit., p. 18.
mera, Ald. and Hanc., in Ann. Nat. Hist., v. 14, p. 330.

Hab. Under stones and in crevices of rocks between tide-marks, common.

Body two or three inches long, but occasionally reaching to four or even five inches;* breadth about half the length; of an elliptical form, nearly equally rounded at both ends. The colour is generally a lemon-yellow or buff-orange; but it is frequently variegated on the upper side with blotches of sage-green, pink, and grayish brown. It sometimes occurs of a very light sage colour, almost white, and young individuals may be procured quite white. The markings are also very variable: occasionally they are numerous and large, covering a great portion of the cloak; at other times they are small, distant, and irregular spots. Full yellow specimens are commonly seen without any markings. *Cloak*

* A specimen of this size was got by Mr. Price, in North Wales, in the spring of 1852, and Sir J. G. Dalyell appears to have met with it nearly of the same dimensions.

thickly covered with flattish, spiculose, unequal tubercles, the smaller ones being very numerous and much less than the others: it extends considerably beyond the foot, and has the margins rather thickish; the under side is smooth. *Dorsal tantacles* slightly conical, yellow, and strongly laminated above, smooth, transparent, and nearly colourless below. The laminæ are upwards of twenty, alternately large and small; the latter not extending so far forwards as the former. *Branchial plumes* nine, tripinnate, recurved, large and spreading; much undulated in outline, and forming an incomplete circle round the anus, open behind. They are transparent, obscure white, with a purple or lilac tinge at the edges, faintly freckled, and can be completely retracted within a cavity, the margins of which close over them. *Head* rather small, with two small tubercular oral tentacles. *Foot* broadish, rounded and grooved in front, less broadly rounded behind, and of a lemon-yellow or orange colour, with the liver appearing through the centre.

Spicula numerous, rather small in proportion to the size of the animal, fusiform, bent in the centre, and bluntly pointed at the ends, rarely with the surface slightly nodulous: those in the tubercles are small and more irregularly bent than the others. The heart pulsates about twenty-eight times in a minute.

Doris tuberculata is a well-known species, common on all parts of the British coast; and though not so plentiful as some of the smaller kinds, it is, on account of its conspicuous size, much more readily observed, and is often the only Nudibranch with which the casual visitors of our sea-coasts are acquainted. It is generally found among rocks about half-tide level, and from thence down to low-water mark. Its favorite resort is within the crevices or under the shelving portions of rocks, hung with small sea-weeds and zoophytes, and incrusted with sponges, on which it feeds. In such places its very beautiful spawn may frequently be observed in the spring or early summer, suspended in an inverted cup- or vase-form, winding into a spiral of about three volutions, with the margins slightly waved. It consists of a broad gelatinous riband attached by one of its edges. When uncoiled, we have found it to measure as much as nine inches in length and nearly an inch in breadth. The ova are placed in transverse lines united in pairs, and amount to about fifty thousand in one mass of spawn. More than one of these masses are generally deposited by the same individual in a season. M. Bouchard Chantereaux has found his *Doris argus*, which is probably a variety of this species, to produce a coil of spawn of twelve inches in length, and he reckons the eggs at eighty thousand. Dr. Johnston met with the spawn of *Doris tuberculata* winding round the stem of a tangle in a spiral frill, and Sir J. G. Dalyell figures a similar elongated spiral, evidently the spawn of this species.

This is a very sluggish animal, seldom changing place when kept in confinement, and crawling very slowly. In its contracted state, as it is usually seen amongst the rocks, it is an unshapely and unattractive animal, being frequently cramped up to suit the inequalities of the surface to which it adheres, and to which it holds so tightly that much force is required to remove it. When placed in a vase of sea-water, however, and its plumes allowed to expand, it is by on means devoid of beauty.

The range of this species is rather uncertain, as the synonyms of continental authors cannot be relied upon. It appears to be equally common on the northern and western shores of France as with us, but we have no decided evidence of its occurrence in the Mediterranean, as the species called *Doris tuberculata* by authors describing the productions of that sea is

distinct from ours. We think that the *Doris tuberculata* of Lovén, found on the Norwegian shores, is also probably distinct, though very nearly allied to our species.

Figs. 1, 2. Side and back views of *Doris tuberculata.*
3. Anterior portion of the underside.
4. Side view of tentacle.
5. Enlarged view of portion of a branchial plume.
6. A portion of the mantle enlarged, showing the tubercles.
7. Spawn.
8. A portion of the same enlarged, showing imbedded ova.
9. One of the ova much enlarged :—*a,* yolk ; *b,* corion.
10, 11, 12, 13, 14, 15. Embryos, showing progressive development :—*b,* corion ; *c,* shell ; *d,* operculum ; *e,* foot ; *f,* oral lobes ; *g,* mouth ; *h,* stomach ; *i,* intestine ; *j,* liver ; *k,* reproductive organs ; *l,* otolithes ; *m,* membranous envelope ; *n,* muscle attaching the embryo to the shell.
16. Spicula from the cloak.

A. Hancock del.

Fig 1–9. DORIS ASPERA Fig 10–16. DORIS PROXIMA

W. Wing lith. Ford & West Imp.

Fam. 1, Plate 9.

Figs. 1 *to* 9.

DORIS ASPERA, Alder and Hancock.

D. ovata, alba, pallio tuberculis validis, clavatis; branchiis 11 parvis, pinnatis, non retractilibus, anum haud propinque cingentibus; capite velato.

Doris aspera, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 32.
For. and Hanl., Brit. Moll., v. 3, p. 567.

Hab. Among the rocks between tide-marks; common on the Northumberland and Durham coasts. Malahide, near Dublin; Ardrossan, Ayrshire, *J. A.* Burghead, Elgin, plentiful, *Geo. Murray, Esq.*

Body about four tenths of an inch in length, ovate, rather depressed, semi-transparent white; rarely of a yellowish tinge. *Cloak* not extending much beyond the foot, covered with rather distant, stout, clavate, flattened tubercles, of nearly equal size, interspersed with a very few smaller ones. The surface between the tubercles has an icy transparency from the spicula shining through: the tubercles are more opaque. *Dorsal tentacles* rather long, nearly linear or slightly tapering, a little bent backwards, with nine or ten rather distant laminæ which have usually a yellowish tinge; the basis of the tentacles are smooth and colourless: apertures smooth, without sheaths. *Branchial plumes* eleven, small, simply pinnate, (with five or six pinnæ,) transparent white; the anterior ones longest, the posterior pair very short, often scarcely shewing themselves above the tubercles. They are set at a little distance from the anus, leaving a small area. *Head* with a semicircular veil, smooth at the margin. *Foot* rather broad, rounded at the ends, and extending a little beyond the cloak behind, when the animal is in progression. It is of a transparent white, sometimes a little yellowish, with a small, oblong, reddish brown patch in the centre from the liver appearing through. There is likewise a pinkish shade on the back of the animal from the same cause.

The spicula are very variable both in size and form. The larger ones are arranged across the back, and diagonally at the sides, with a few of a slightly waved form running completely round the cloak at a little distance from the margin. Small spicula are clustered into the tubercles radiating at their base. Their usual shape is fusiform, obtusely pointed at the ends, and a little bent in the centre, where there is generally a spur or branch, but many of the smaller spicula, especially in the branchiæ and the margin of the cloak, are crucial or dagger-shaped, and this quadriradiate form is found, though less frequently, among the larger kinds. From the crowding of spicula in the skin, and the large hard tubercles, the animal feels firm and harsh to the touch.

This Doris appears to be rather local, but is one of the commonest species on the north-

eastern coast of England, where it is found under stones near low-water mark; sometimes four or five under one stone. From its small size, it appears to have escaped the notice of naturalists, or it may have been passed over as the young of *D. pilosa*. We have few records of its capture on the western coasts, where its place seems to be taken by nearly allied species.

Doris aspera comes very near the *D. muricata* of Müller, from which it differs principally in its smaller size, rather smaller tubercles, and almost constant white colour. There is, however, a group of species in this section of *Doris* so nearly resembling each other, that it requires more detailed characters than those given by Müller to discriminate them. *D. fusca* of Fabricius (a white species), and *D. acutiuscula* of Möller, appear to be very nearly allied to *D. aspera*. Our *D. proxima* is also very closely related.

The *Doris aspera* of Macgillivray must be something different from ours, as he describes it as having two small oral tentacles and the branchiæ retractile. It was probably a very young white variety of *D. tuberculata*.

This is comparatively an active animal, more restless than most of its congeners. When kept alive for observation, it frequently floats inverted at the surface of the water, and, like most of the littoral *Dorides*, it is apt to creep out of the water, and, if left over night, will often be found dead and dried up in the morning on the side of the glass.

It spawns in May, June, and July. The spawn is deposited in a narrow coil of two or sometimes three volutions, and is from a quarter to four tenths of an inch in diameter. The eggs are white, and rather thinly scattered through the gelatinous envelope without apparent order.

Figs. 1, 2, 3. *Doris aspera*, different views.
4. A dorsal tentacle.
5. A branchial plume.
6. A portion of the cloak, much enlarged.
7. Spicula.
8. Spawn.
9. A portion of the same, shewing the arrangement of the eggs.

Fam. 1, Plate 9.

Figs. 10 *to* 16.

DORIS PROXIMA, Alder and Hancock.

D. elliptica, flava; pallio tuberculis validis, ellipticis; branchiis 11 pinnatis, non-retractilibus, anum haud propinque cingentibus; capite velato.

Hab. Among rocks and sea-weeds between tide-marks. Birkenhead, *J. Price, Esq.*

Body half an inch in length, elliptic-oblong, not much depressed, of a deep yellow or orange colour, varying in some specimens to pale yellow or white. *Cloak* covered with stout, subclavate, or elliptical bluntly-pointed tubercles, set at a little distance apart, and mixed with smaller ones. The spicula appear through the skin, radiating from the tubercles. *Dorsal tentacles* linear, slightly enlarged above, and obtusely pointed, with about fifteen laminæ reaching nearly to the base of the tentacle. They are usually of an orange-colour, deeper in shade than the cloak. The margins of the cavities are smooth. *Branchial plumes* eleven, the two posterior ones on each side small, yellowish, simply pinnate; the pinnæ are about six in number, of irregular length, and the plumes abruptly pointed: they are set in a small circle scarcely so close to the anus as in the preceding species. *Head* with a broad veil, having a large opening for the protrusion of the mouth. *Foot* rather broad, a little truncated in front, and rounded behind; orange-yellow, the liver appearing through the centre of a purplish colour, and extending much forward. Anterior margin with a frontal lamina.

The spicula are of various sizes, fusiform, with blunt points, and more or less bent, with a short spur or tubercle at the bending, which is usually nearer one end. So far as we have seen, none of the spicula are crucial or triradiate.

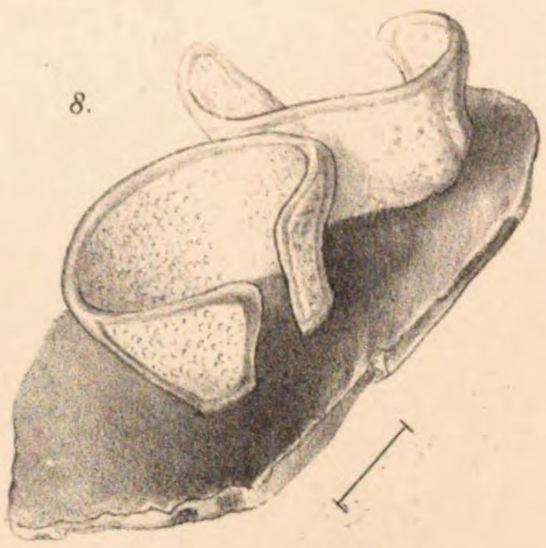
This at first sight appears to be a critical species, approaching as it does in external characters very closely to *D. aspera*, with which we were at one time inclined to unite it, but a minute analysis brings out several points of difference which we think would alone justify us in considering it distinct; but the number and character of the lingual spines* at once establish its right to rank as a species; indeed the tongue differs so widely from that of *D. aspera* and its allies, that some naturalists might be disposed to consider them generically distinct. The best external character is the form of the tubercles, which in this species are elliptical or fusiform and obtusely pointed at the top, and not flatly rounded as in *D. aspera;* the tentacles, too, have more numerous laminæ and are thicker towards the top, and the liver,

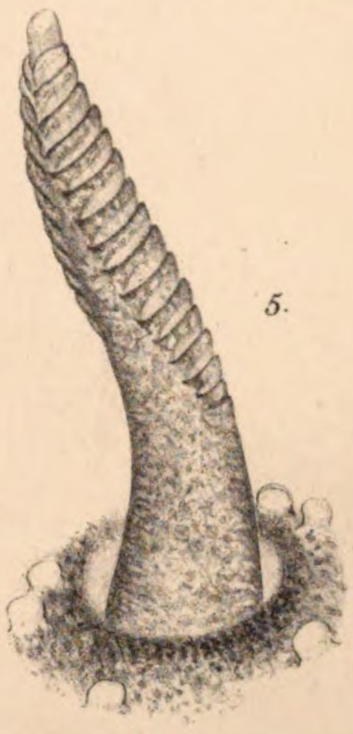
* See Pl. 46.

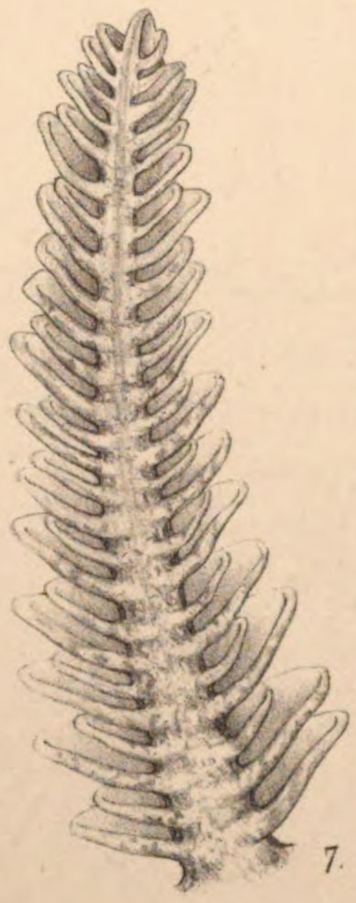
as seen through the foot, is of much larger volume and extends farther forward than in the other species. The character derived from the liver, in the different species of Doris, is very constant. In its general appearance *D. proxima* is rather larger, and usually of a much deeper colour than *D. aspera*. The latter, indeed, is almost constantly white, and in only one or two rare instances have we seen it of a yellowish hue.

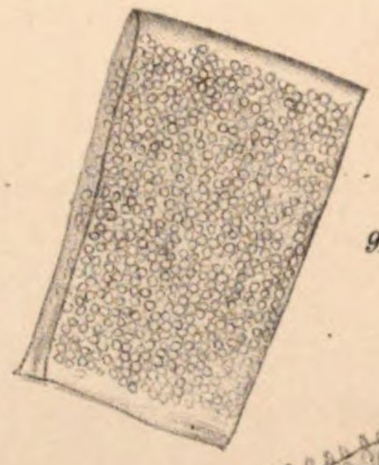
Mr. Price, to whom we are indebted for the knowledge of this species, informs us that it is not uncommon on the shore at Birkenhead during the spring months, but was more abundant a few years ago, before the recent great alterations in that locality. It spawns about the latter end of February. "The ova are dull yellow, thickly scattered through a transparent riband, forming an oblong, angular spiral, very inconspicuous on the brown stones. The ova contain two, three, or four yolks each."

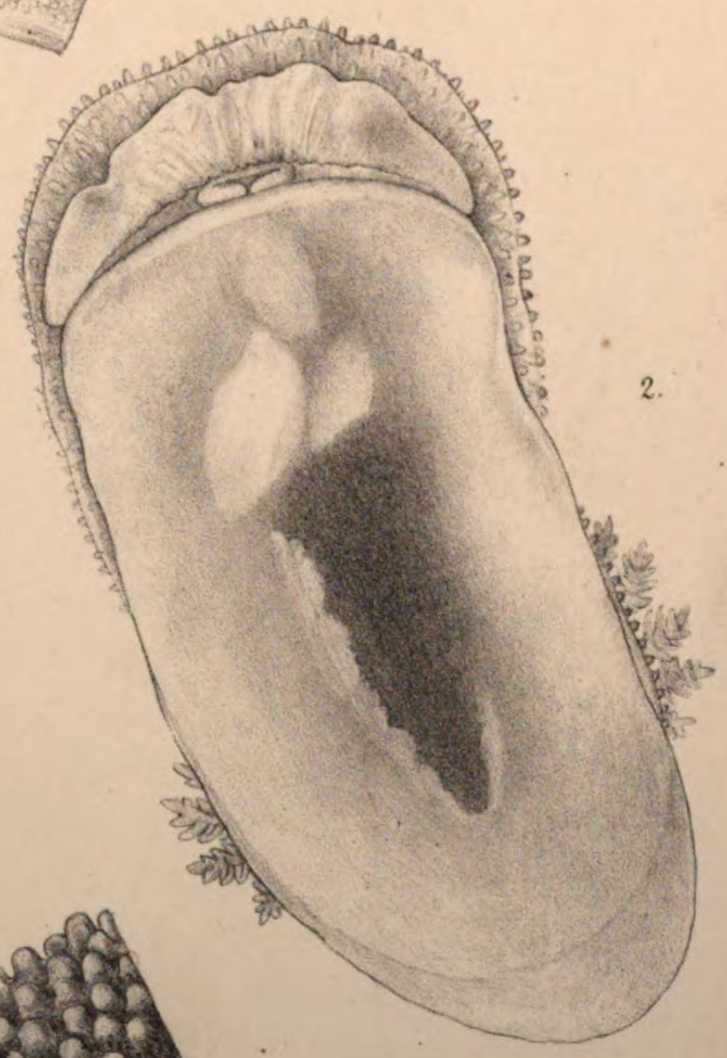
Figs. 10, 11. Back and foot views of *Doris proxima*.
12. A portion of the mantle much enlarged.
13. A branchial plume.
14. A dorsal tentacle.
15, 16. Spicula.

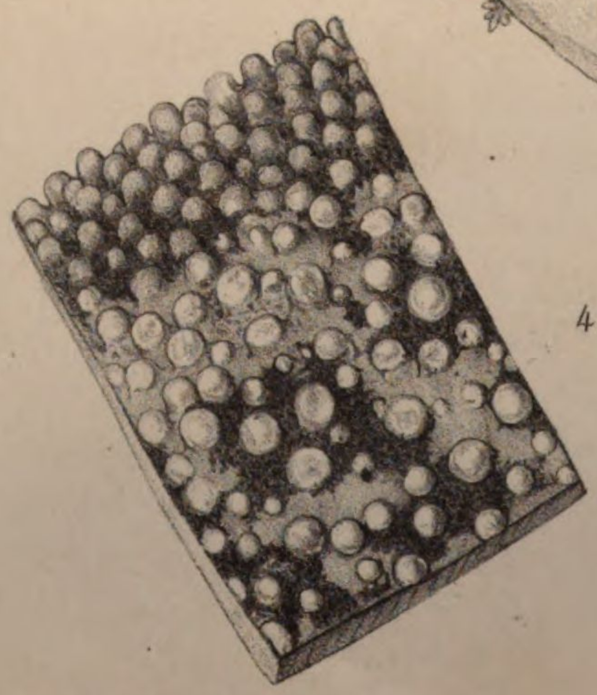












A. Hancock del. W. Wing lith.

Printed by Hullmandel & Walton.

DORIS BILAMELLATA.

DORIS BILAMELLATA, Linnæus.

D. elliptica, albida, fusco longitudinaliter notata; pallio tuberculis magnis clavatis obtecto; branchiis numerosis, pinnatis, 20-29 parvis, circum anum remotè et transversè incurvatis; capite velato.

Doris bilamellata, Linn., Syst. Nat. 12th Ed., v. 1, p. 1083.
Johns., in Ann. Nat. Hist., v. 1, p. 53, pl. 2, f. 8.
Thomp., in Ann. Nat. Hist., v. 5, p. 86.
Macg., Moll. Anim. Aberd., p. 198.
For. and Hanl., Brit. Moll., v. 3, p. 567.
fusca, Mull., Zool. Dan. Prod., p. 229, no. 2768?
Idem, Zool. Dan., pl. 47, f. 6—9 (non desc.)
verrucosa, Penn., Brit. Zool., v. 4, p. 43, pl. 21, f. 23.
Turt., Brit. Faun., p. 133.
Flem., Brit. Anim., p. 282.
vulgaris, Leach, Syn. Moll. Gr. Brit., p. 19.
Elfortiana, Blainv., Bull. des Scien. 1806, p. 95, (sec. Leach.)
Leach, Syn. Moll. Gr. Brit., p. 20, pl. 7, f. 1.
Leachii, Blainv., Bull. des Scien., v. 13, p. 450, (sec. Leach.)
affinis, Thomp., in Ann. Nat. Hist., v. 5, p. 85.
liturata, 'Beck,' Möller, Ind. Moll. Grœnl., p. 5.
obvelata, Bouch. Chant., Catal. des Moll. du Boul., p. 42.

Hab. On and under stones, between tide-marks, common.

Body from half an inch to an inch and a quarter long, and about half as broad when extended, of an elliptical form, nearly equally rounded at both ends. *Cloak* not extending much beyond the foot, covered with stout, not much crowded, clavate, strongly spiculose tubercles, of unequal sizes, being largest down the sides and about the branchial region, smaller and more thickly set on the centre of the back, and also becoming small towards the margin of the cloak. The colour is a dull yellowish white, marbled with umber brown; the brown markings forming three indistinct bands down the back; those on the sides are generally darkest in colour, but very much interrupted and irregular in form; that on the centre of the back is more uniform, but less intense. The brown usually extends round the bases of the tentacles, and the markings are mostly confined to the spaces between the tubercles. In some individuals they are very indistinct, and in others entirely wanting; but specimens without markings are comparatively rare. The under surface of the cloak is slightly granulated. *Dorsal tentacles* slender and nearly linear, swelling a little at the base, brown, finely laminated for about three quarters of their length in front; the upper laminæ only

meeting behind, the rest gradually becoming shorter, so as to leave a wedge-shaped, smooth portion at the back of the tentacle. There are fourteen or sixteen laminæ; the apex is small and not much produced. The margins of the tentacular cavities are plain, without tubercles. *Branchial plumes* small, simply pinnate, rather variable in number, reaching from twenty to twenty-nine in large individuals, but fewer in smaller specimens. They are placed round the vent, in a transverse elliptical groove, nearly straight in front and open behind, the ends being much curved inwards: the included space is strongly tuberculated. *Head* with a broad veil, having the margins a good deal waved and extended laterally. *Foot* rather broad, rounded in front, less broadly rounded and extending a little beyond the cloak behind, when the animal is crawling. It is of a yellowish white colour, the liver appearing through the centre of a purplish hue, but not very large.

The spicula of the cloak are smallish and rather stout, blunt at the points, and more or less bent in the centre, with usually a small inclined spur or branch at the bending. They are arranged in a stellate form round the tubercles. The spicula of the tubercles are very small.

The spawn forms a compressed coil of one, or, occasionally two volutions, cemented to the surface of stones and rocks by one of its margins; spreading at the top, and often a little curved outwards, so as to give it a vase-like outline. That of a large individual measured a quarter of an inch in height, and half an inch in diameter at the top; usually, however, it is not above half that size. The eggs are small and very numerous, showing a slight indication of a linear arrangement in their early stage of development, which afterwards disappears. We have taken the spawn in February, June, August, and November; but the principal breeding season is apparently in February, when large quantities of the spawn may be seen crowded together, forming patches of no inconsiderable size. In August, too, it has occurred to us in abundance. This species has, therefore, probably two breeding seasons, one in early spring, the other at the end of summer.

This is one of the most common Dorides on all our rocky coasts. It is occasionally met with in considerable numbers between tide-marks, especially in the spring; but a few individuals may be found in such localities all the year through. It varies exceedingly in size, in which respect two varieties are distinguishable, one nearly twice the size of the other, not, however, without occasional intermediate specimens. This disparity of size has led to the supposition that there might be two species, and they have been described as such, but after a careful examination of both kinds, we have been unable to fix upon any character to distinguish them, unless the increased number and greater development of the branchial plumes might be taken as specific; but we find this character, contrary to what is usual among the Nudibranchs, so very variable in this species, that we have not thought it safe to rely upon it, especially as the very peculiar arrangement of the plumes is the same in both, as well as the colour and markings of the cloak.

The *Doris affinis* of Thompson, a specimen of which, presented by our lamented friend, is now before us, was described from spirits, and the elongated character of the lateral tubercles, which was chiefly relied upon, appears to be owing to the state of preservation of the specimen. The same character is given as distinctive in the *Doris Elfortiana* of Blainville and Leach, which we take to be likewise a variety of *D. bilamellata*, judging from specimens in the British Museum, as well as from a living example sent us from the Frith of

Forth, the original locality mentioned by Dr. Leach, where he states it to be very abundant. M. de Blainville says that he founded his genus *Onchidoris* on a specimen in the British Museum. It is rather remarkable that the specimen preserved in the Museum collection with the name of '*Onchidoris*, Blainv.' attached to it, should be an individual of *D. bilamellata*, in which no such characters as he establishes his genus upon are to be found. Besides, he figures in the 'Manuel de Malacologie' an animal with the plumes retracted within a single cavity, according to his description. There is evidently a mistake somewhere with respect to this genus, and until a mollusk can be found with the characters assigned to the genus *Onchidoris*, it is desirable that it should remain in abeyance.

Dr. Johnston was the first, we believe, to recognise in the species now under consideration the *Doris bilamellata* of Linnæus, and it may be necessary to say a few words with respect to the propriety of adopting this view. We do not of course profess to unite our species with the *Limax bilamellatus* of the 'Fauna Suecica,' which appears to have been an intestinal worm, but to that form of *Doris bilamellata*, in the 12th edition of the '*Systema Naturæ*,' to which the more detailed description belongs, stated, on the authority of J. G. Koenig, to be "frequent on stones" in Iceland. The description, 'anus *transversus*, supra postice corpus, ciliatus plumis *simplicibus*,' very well characterises our species, and Müller's figure of *Doris fusca* in the 'Zoologia Danica,' which he makes synonymous with *D. bilamellata*, Linn., undoubtedly represents it, though the description, as Professor Lovén has pointed out to us, belongs to a different species. The drawing was furnished by M. Koenig, from whom Linnæus received his specimens, and may therefore be taken as a correct representation of the Linnean *Doris bilamellata*.

This species appears to be widely distributed through the seas of northern Europe, having been found in Greenland (Möller), Iceland (Koenig), and France (Bouchard). M. Lovén does not mention it in the Scandinavian Fauna, though we think it probable that it will be found on the Norwegian coast.

Fig. 1, 2, 3. *Doris bilamellata*, different views.
4. A portion of the cloak, much enlarged, showing the tubercles.
5, 6. Back and front views of tentacles.
7. Enlarged view of branchial plume.
8. Spawn.
9. A portion of the same more highly magnified, exhibiting the ova.
10. Spicula.

A. Hancock del. W. Wing lith.

Ford & West. Imp.

EOLIS PAPILLOSA

Fam. 3, Plate 9.

EOLIS PAPILLOSA, Linnæus, Sp.

E. ovato-oblonga, depressa, fusca, grisea, vel aurantiaca, brunneo et albo maculata; branchiis numerosis, conicis, subcompressis, in seriebus 18—24 digestis; tentaculis dorsalibus parvis subconicis; tentaculis labialibus planiusculis; angulis anterioribus pedis brevibus.

Doris spinis mollibus hirsuta, Baster, Op. Subs., v. 1, p. 81, pl. 10, f. 1.
Limax papillosus, Linn., Syst. Nat., 12th ed., v. 1, p. 1082.
Doris Bodoensis, Gunn., Act. Hav., v. 10, p. 170, f. 1—13. (Copied in Encyc. Meth., pl. 82, f. 12.)
papillosa, Müll., Zool. Dan. Prod., p. 229. (Non Zool. Dan.)
Fab., Faun. Grœnl., p. 345.
Mont., in Linn. Trans., v. 11, p. 16, pl. 4, f. 3.
vermigera, Turt., Brit. Faun., p. 133.
Eolis Cuvieri, Lam., Anim. s. Vert., 2d ed., v. 7, p. 450, (excl. Syn. Cuv.)
Bouch. Chant., Catal. des Moll. du Boul., p. 33.
Stark, Elem. Nat. Hist., v. 2, p. 69.
Eolida papillosa, Flem., Brit. Anim., p. 285.
Eolidia papillosa, Johns., in Loud. Mag. Nat. Hist., v. 8, p. 376, f. 35.
Idem., in Ann. Nat. Hist., v. 1, p. 118.
Thompson, in Ann. Nat. Hist., v. 5, p. 89.
Cuvieri, Leach, Syn. Moll. Gr. Brit., p. 23, pl. 7, f. 3.
Eolida Zetlandica, Forbes and Goodsir, in Proc. Brit. Assoc., 1839. Athenæum, No. 618, p. 647.
Æolidia Bodoensis, Möller, Ind. Moll. Grœnl., p. 5.
Æolis papillosa, Lovén, Ind. Moll. Scand., p. 7.
Macg., Moll. Anim. Aberd., p. 192.
Murrayana, Idem, Moll. Anim. Aberd., p. 193.
Lesliana, Idem, Moll. Anim. Aberd., p. 194.
Eolis rosea, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 34.
obtusalis, Idem, in Ann. Nat. Hist., v. 9, p. 34.
papillosa, For. and Hanl., Brit. Moll., v. 3, p. 590.
Dalyell, Pow. Creat., v. 2, p. 314, pl. 45, f. 23—27.

Hab. Among rocks and under stones from beyond low-water mark to half-tide level, frequent on nearly all our rocky coasts.

Body from an inch and a half to three inches long,* ovate, depressed, rather broad

* Mr. Cocks has sent us a drawing, "natural size," of a monster specimen found at Falmouth, measuring $4\frac{1}{2}$ inches; and Sir J. G. Dalyell had an individual 4 inches long, "measured from the tip of the tentacula to the extremity of the tail."

in front and tapering to a fine point behind. Colour various, brown, gray, or yellowish, always more or less spotted and freckled with lilac, gray or brown, and opaque white. *Dorsal tentacles* simple, short, conical, somewhat truncated, and very contractile, generally brown with white or yellowish tips, sometimes very dark, and occasionally pink or orange coloured. *Oral tentacles* short, about the same length or a little longer than the dorsal pair, pale in colour, and set wide apart on the head, the outline of which in front is a little curved and slightly notched in the centre. Between the two pairs of tentacles there is usually a triangular yellowish white mark, formed by confluent spots of opaque matter; the angles are prolonged into lines, the basal passing into the oral tentacles, the apical, going backwards, passes between the dorsal tentacles, and reaching the swelling indicating the region of the heart, expands and forms there another triangular white spot having its base backwards; from the lateral angles of this spot the white is continued in broken lines round the sides of the heart, and uniting behind it, forms a broadish line that passes some little way down the centre of the back. From this arrangement of the white markings, the freckling produces a dark spot over the centre of the heart. These markings are not always present, and are sometimes entirely wanting: pale lines, however, bordered with dark, usually indicate their position. The back is also blotched or thickly spotted with brown and white; the dark spots becoming thicker and more intense on the borders of the white markings. *Branchiæ* very numerous, conical, stout and flattened, having a curved leaf-like outline when contracted, but capable of great extension when the animal is in action. Their colour is usually brown, from a thick freckling of that colour over the surface, intermixed with white: when the white predominates it gives the branchiæ a grayish appearance. This freckling is occasionally lilac or gray, and does not extend to the base and under surface. The tips are whitish. The central gland is yellowish-brown and much lobated, but seldom distinctly visible outside, except on the under side or towards the base. The extreme lateral papillæ are often pinkish or salmon-coloured. The papillæ are set in from eighteen to twenty closely imbricated rows of twelve to twenty-four each, sloping transversely across the sides, and leaving the centre of the back bare in front, but nearly meeting behind. The front rows extend very far forward at the sides of the head, nearly reaching to the bases of the oral tentacles; the papillæ on this part are small. *Foot* transparent white, showing through its surface the rose-coloured ovaries, rather broad, especially in front, where it is a little convex in outline and deeply grooved, extending into short angles at the sides. It terminates in a point not far behind the branchiæ, but the animal has the power of occasionally elongating and attenuating it to a considerable extent backwards.

The heart beats seventy-two to seventy-six times in a minute.

Eolis papillosa varies so much both in form and colour, that it has given rise to many spurious species, especially in its young state, when the number of papillæ is also fewer. It will be necessary, therefore, to particularise some of the more prominent varieties. There are two forms met with on the Northumberland coast; the one is dark brown and rather broad, with the branchiæ very numerous and stout; the other, which is usually grayish, is more slender in its proportions, and has the branchiæ and tentacles a little longer. A yellowish variety is also occasionally brought in from deeper water, the young state of which is our *E. obtusalis*. We also now consider our *E. rosea* to be the young state of a variety with rose-coloured branchiæ, having once taken a full-grown individual of that colour; this

had the papillæ much covered with opaque white. On the coasts of Devonshire and Cornwall, an orange or buff variety is more common. In Torbay we got it very large, with the branchiæ yellowish or fawn-coloured, speckled with brown and white, the back being yellowish spotted with lilac. At the Salt Rock in Salcombe Estuary we found an orange variety very adundant: the branchiæ varied from pale buff to reddish orange, spotted with white; there were very few with brown spots, and these were confined to the head and front rows of branchiæ only; the triangular mark was generally present on the head, and the back was always opaque white, occasioned by confluent spots. The colour of this species on the Cheshire coast, according to Mr. Price, is always a buff ground sprinkled with purple, and the dorsal papillæ powdered with silvery white towards the tips, but varying greatly in intensity of tint from nearly black to fawn-colour, and a uniform horny appearance. *Eolis Lesliana*, of Macgillivray, which we have no hesitation in referring to this species, has the branchiæ of a faint pinkish tint, margined and tipped with white.

There can be little doubt that this species is the '*Doris spinis mollibus hirsuta*' of Baster, described as two inches in length, and found on the coast of Holland: and as Linnæus in his '*Systema Naturæ*,' quotes Baster's figure as representing his *Limax papillosus*, we have followed Montagu, Fleming, and other British authors in considering our animal the true Linnean species, though *it* may not be the *Limax papillosus* of the 'Fauna Suecica,' which it would be impossible now to identify. French authors have considered this species the *Eolis Cuvieri*, on the authority of the synonyms given by Lamarck, but an examination of Cuvier's description and figures will be sufficient to show that this is not the species described in the 'Mémoires des Mollusques.' That species is represented with long processes at the sides of the foot, which Cuvier calls a third pair of tentacles, a character not to be found in *E. papillosa*; besides, the animal is more slender, and the tentacles and branchiæ much longer than would be the case with the latter when preserved in spirits. There are other *Eolides* coming much nearer to Cuvier's species than *E. papillosa*, but we are afraid, from the necessary imperfection of a description taken from spirit specimens in this genus, the identification of it will be very difficult, if not impossible.

This species spawns during the spring and summer months, when it may often be found plentifully under stones between tide-marks, on a rocky or shingly coast, especially where the bottom is a little muddy. It generally occurs a considerable way above low-water mark, and in situations left dry; rarely in pools, as is commonly the case with the *Eolides*. The spawn consists of a gelatinous cord, very much convoluted and waved, so that its spiral form is not readily detected at first sight. It is attached to stones in such a manner as to give it a festooned appearance when floating in the water. The eggs are scattered irregularly through the cord in groups, interrupted at intervals: each contains two or three embryos. The mass is occasionally white, but has generally a pinkish tinge, and is sometimes distinctly rose-coloured. Professor E. Forbes states that the dark variety he called *E. Zetlandica* has the spawn pure white. We have observed that the spawn of the orange variety found on the south coast is also white, but in other places the white and pinkish kinds are intermixed promiscuously, so that no character can be derived from it.

Eolis papillosa is pretty generally diffused through the seas of Northern Europe; and we believe has been found on the shores of North America. We have no account of its occurrence in the Mediterranean or any more southern locality.

EOLIS PAPILLOSA.

Mr. Price, whose success in keeping marine animals is well known, informs us that *E. papillosa* does well in confinement. Its voracious habits, however, make it an unpleasant neighbour. He has observed it to attack an *Actinia gemmacea,* kept in the same vessel, and even to enter its mouth with impunity. There may be something in the mucus, which this *Eolis* exudes very copiously, injurious to other animals, or it may be that the urticating bodies from the papillæ may have some powerful effect, otherwise we should wonder at its temerity in venturing within the clutches of so powerful an antagonist.

The following interesting account of a similar attack on the Helianthoid Zoophytes has been communicated to us by Mr. Gosse.

"Last spring, when at Torquay, I kept in a large pan of sea-water many kinds of marine animals. Among these were a fine specimen of *Anthea cereus* (the variety with rose-tipped satin-green tentacles) and three of *Eolis papillosa.*

"One day I found the largest *Eolis papillosa* eating the tentacles of the *Anthea,* and when I attempted to pull it away, it held so firmly that the mouth was almost everted. Soon afterwards I again found it at the same work of destruction, and one of the smaller specimens was attacking the unfortunate *Anthea* also. The mollusks were eager and fierce, stretching forward to their prey from their points of attachment, to which they adhered only by the extremity of the foot; and frequently erecting and reversing their crowded branchiæ. On being again removed, they again returned, though from a considerable distance, so that when I looked at the pan, I almost always found one or both the *Eolides* devouring their victim, so much larger though more sluggish than themselves. The tentacles, when gnawned and torn, presently became shrivelled; some of them were torn away by the *Eolides,* and a large quantity of viscid albuminous matter was discharged in the form of irregular threads or webs attached to surrounding objects. The process of devouring went on from day to day.

"On one occasion, one of the *Eolides* attacked a magnificent *Actinia crassicornis* in the same vessel, and had eaten a hole in its side as large as a pea before I discovered the mischief."*

We have taken from the mouth and stomach of this species, minute specimens of the common mussel.

Figs. 1, 2, 3. *Eolis papillosa,* different views.
4. Two branchial papillæ, upper side.
5. Under side of a branchial papilla.
6. Spawn.
7. A portion of the same.
8. The same, exhibiting ova.
9. A few of the ova much enlarged.

* This account has since been published in the very interesting 'Rambles of a Naturalist on the Devonshire Coast,' p. 15.

A. Hancock del. W. Wing lith.

Fig. 1-4 EOLIS PEACHII Fig. 5-6 EOLIS ALDERI

Hurst & West Imp.

Figs. 1 *to* 4.

EOLIS PEACHII, Alder and Hancock.

E. oblonga, sub-depressa, lutescens vel carnea; branchiis numerosis, sub-clavatis, obtusis, luteo-fuscis, apicibus albis, in seriebus 20 digestis; tentaculis dorsalibus longiusculis, lævibus; tentaculis labialibus brevioribus; capite lunato, lateribus productis; angulis anterioribus pedis obtusis.

Eolis Peachii, Ald. and Hanc., in Ann. Nat. Hist., 2d Ser. v. 1, p. 191.
For. and Hanl., Brit. Moll., v. 3, p. 591.

Hab. Fowey Harbour, Cornwall, *C. W. Peach* and *J. A.* Cullercoats, *J. A.*

Body about three quarters of an inch long, broadish in front, and tapering gradually to a point behind; buff-coloured, deepening to a rosy flesh-colour on the back, from the ovary appearing through. *Dorsal tentacles* rather long, linear, smooth, approximating. *Oral tentacles* about two thirds the length of the dorsal pair, set rather wide apart on the head. They originate from the margin of the lip, but a ridge passes from them upwards on the external side, giving them the appearance as if cemented to the upper surface of the lip. Both pairs are buff-coloured. *Head* very broad, as wide as the foot, semicircular or lunate, produced at the sides, and terminating posteriorly in a blunt point on each side. *Branchiæ* very numerous, slightly clavate, obtuse at the apex; the central gland yellowish brown or fawn-coloured, a little uneven in outline, and granulated; apices white. The papillæ are set in upwards of twenty very dense rows, extending close to the tail behind, and running along the sides of the head in front, so as nearly to surround the dorsal tentacles: the rows contain about eight or nine papillæ each. *Foot* pale buff, of a rosy appearance in the centre when the animal is filled with spawn: it is rather broad in front, tapering gradually to a blunt point behind.

This well-marked species was first met with in Fowey Harbour, Cornwall, where it was dredged by Mr. Peach, and subsequently by ourselves. We afterwards got a single specimen at Cullercoats, from a zoophyte brought in by the fishing-boats.

The Fowey specimens, which were taken at the end of May, were filled with mature spawn.

The peculiar form of the head in *E. Peachii,* similar to what is found in *E. nana,* but more strongly marked, and the agreement of these two species in most of their other characters, including the tongue, induce us to think they ought to form a distinct section of the genus, intermediate, in some respects, between our first and third sections.

Figs. 1, 2, 3. *Eolis Peachii,* different views.
4. Three of the branchial papillæ, much enlarged.

Fam. 3, Plate 10.

Figs. 5 *and* 6.

EOLIS ALDERI, Cocks.

E. griseo-albida, depressa; branchiis subconicis, leviter depressis, seriebus 12—14 crebre digestis, ordinibus 2 vel 3 anterioribus albis, reliquis griseo-fuscis, apicibus flavis; tentaculis flavis; angulis anterioribus pedis paululum productis.

Eolis Alderi, Cocks, in Naturalist, v. 2, p. 1, pl. 1, f. 1.

Hab. In pools between tide-marks, Gwyllyn Vase, Falmouth, *W. P. Cocks, Esq.*

Body five to seven tenths of an inch in length, transparent white, with opaque white spots. *Dorsal tentacles* linear, nearly smooth or a little wrinkled, approximating, of moderate length and bright yellow. Oral tentacles a little longer than the dorsal ones, white tipped with yellow, set rather above the margin of the head. *Branchiæ* very numerous, sub-conical, a little flattened, and tapering gradually towards the top; arranged in from twelve to fourteen dense rows, nearly covering the whole of the back, extending round the sides of the head in front, and reaching very nearly to the tail behind. The first two, or sometimes three, rows are opaque white, the remainder are gray marbled with pale purplish brown, and profusely spotted with white: the apices are yellow or pale orange with the extreme tips pale. *Foot* transparent white, a little rounded in front, and produced into short angles at the sides; the posterior extremity is extended into a fine point.

For the knowledge of this species we are indebted to our friend Mr. W. P. Cocks, who found it very abundant at Falmouth in the summer of 1848. During that year, he informs us that he got nearly seventy specimens. It was scarce in 1849, and from that time to the present he has not seen a single specimen. It comes very near to our *E. glauca,* but Mr. Cocks, who has had the opportunity of studying both species in a living state, considers it quite distinct. The white ruff, formed by the first two rows of papillæ, he assures us is a permanent and good character in this species, besides that it is never more than half the size of *E. glauca* in the adult state, and the colour is also different. Unlike *E. glauca,* this is a very active and restless creature, erecting its branchiæ and shewing much irritability when disturbed. It spawned profusely in confinement. The ova, which are deposited in July and August, are contained in a pellucid membrane of a cylindrical form, attached by the lower surface. From the drawings we have been favored with, it appears to form a much waved spiral, with a single row of eggs sparingly distributed through it. In this character the spawn differs from that of any other British *Eolis.* Mr. Gosse has observed a similar arrangement of the ova in *Antiopa cristata.*

The specimen of this *Eolis* from which our drawing was taken is the only one that reached us in a living state.

Fig. 5. *Eolis Alderi,* side view.
6. Two of the branchial papillæ, much enlarged.

A. Hancock del.

W. Wing lith. Ford & West Imp.

EOLIS GRACILIS

EOLIS GRACILIS, Alder and Hancock.

E. gracilis, alba; capite longiusculo; branchiis aurantiacis, apicibus albo-annulatis, in fasciculis 4 digestis; tentaculis longis, brevibus; angulis anterioribus pedis productis.

Eolis gracilis, Ald. and Hanc., in Ann. Nat. Hist., v. 13, p. 166.
For. and Hanl., Brit. Moll., v. 3, p. 595.

Hab. Under stones, and on corallines, at low-water mark, and a little above, rare. Cullercoats, and Whitley, *A. H.* Newbiggin, Northumberland; and Menai Straits, *J. A.*

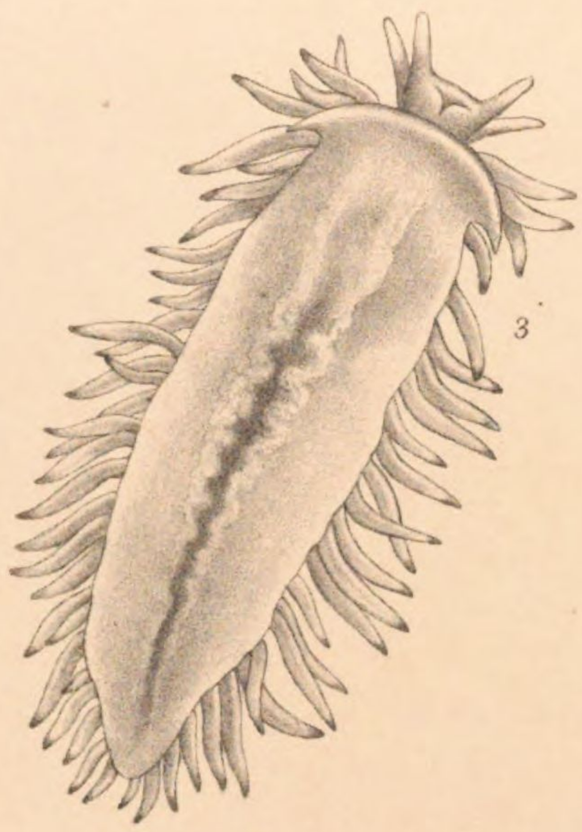
Body rather more than half an inch long, very slender, pellucid white, tinged in the centre with pale greenish yellow, from the viscera appearing through. *Head* rather long and narrow. *Dorsal tentacles* long, slender, linear and smooth, approximating at the base, and much inclined forward; transparent white, with opaque tips, which are carried widely apart. *Oral tentacles* also slender, and a little exceeding the dorsal ones in length, set on a line with the sides of the head, and generally held in a graceful curve. *Branchiæ* slightly elliptical, slender, orange-red, with a delicate opaque white ring near the apex; the central gland, when viewed through a lens, is slightly granular. They are set in four clusters down each side of the back; the first cluster containing twelve or fourteen papillæ, the second ten, and the posterior ones fewer. *Foot* slender, transparent white, grooved in front, where the outline is rather convex, extending into moderately-sized tentacular points at the sides; and terminating in a rather obtuse point behind, considerably beyond the papillæ.

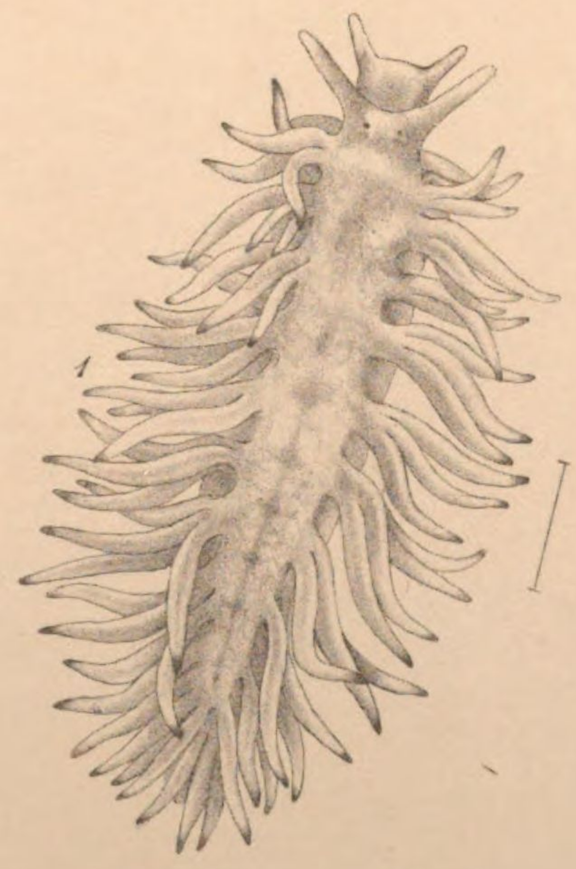
This delicate and graceful *Eolis* has been found occasionally on the Northumberland coast, where it is by no means common, and must be considered among the rarer species of the genus. Beyond that locality a single specimen only has been met with, which was taken by the dredge in a few fathoms' water in the Menai Straits. It spawns in May, on the underside of stones. The spawn forms a spiral cord of four or five volutions, a little waved. The ova are numerous, and closely arranged through the cord, about six or seven in width, but without apparent order.

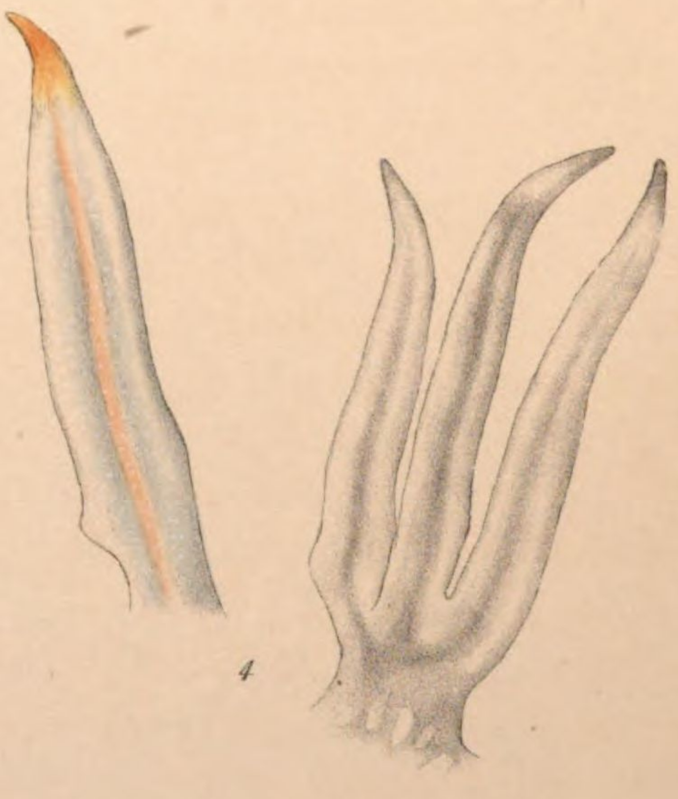
The specimen from which the original description was taken, had the papillæ of a ginger-orange colour, and was more attenuated in form than any we have since taken; the head, too, was narrower, and the tentacles longer; but notwithstanding these and other minor differences, we are not inclined to elevate these two varieties to the rank of species. It is desirable, however, to see more specimens of the ginger-orange coloured form.

This species moves very gracefully, carrying the dorsal tentacles much forward and perfectly straight, while the oral ones are waved about in elegant curves.

Fig. 1, 2, 3. *Eolis gracilis*, different views.
4. Three of the papillæ.
5. Spawn.
6. A portion of the same showing the arrangement of the eggs.







J.Alder del. W.Wing lith.

Ford & West. Imp.

EOLIS GLAUCOIDES.

Figs. 1 *to* 4.

EOLIS GLAUCOIDES, Alder and Hancock.

E. alba, depressa, capite parvo; tentaculis parvis, simplicibus; branchiis linearibus, albis, apicibus fulvis, glandulâ centrali subfulvâ, in fasciculis pedunculatis 11 utrinque digestis; pede lato, angulis anterioribus acutis.

Hab. Under stones at low water mark, Herm Island, near Guernsey, *J. A.*

Body about half an inch long, depressed, rather broad, transparent white, with opaque white spots. *Head* small and narrow. *Dorsal tentacles* short, linear, simple, white with opaque tips. *Oral tentacles* very short, and broadish at the base. *Branchiæ* nearly linear, tapering towards the top, transparent white, covered with minute opaque white spots; the central gland is narrow, linear, and of a pale fawn colour; the apices yellowish, deepening into fawn colour towards the tips. They are set in eleven clusters, of three or four papillæ each, down the sides of the back, each cluster arising from a short foot-stalk; they commence near the tentacles, and reach nearly to the tail, the posterior papillæ extending a little beyond it. A few of the papillæ nearest the back have a slight angle towards the base. *Foot* broad, and rather thin at the edges, arched in front, and extending into acute angles at the sides; terminating behind in an obtuse rounded tail. It is transparent white, with a darkish line down the centre from the gastro-hepatic vessel appearing through. A less distinct, interrupted darkish line is visible down the centre of the back.

This very curious *Eolis* shows, in most of its characters, an approach to the genus *Glaucus*, particularly in the small size of the head and tentacles, and in the branchial papillæ being arranged in clusters, arising from a short foot-stalk. Its anatomical characters bear out this resemblance. A remarkably large and wide gastro-hepatic vessel occupies the centre of the body, giving off branches on each side to the branchial pedicles. The ovary, which, from the transparency of the skin, is visible outside, is divided into two lateral portions, which pass down the body, and are united posteriorly above the gastro-hepatic vessel. The jaws are small and truncated behind; and the tongue is very minute, long, and slender, composed of a single series of plates, each bearing a single spine.

When the genus *Eolis*, as we at present retain it, comes to be broken up, this species will probably constitute a new generic type.

Figs. 1, 2, 3. *Eolis Glaucoides*, different views.
4. Branchial papillæ more highly magnified.

Fig. 5.

EOLIS STIPATA, Alder and Hancock.

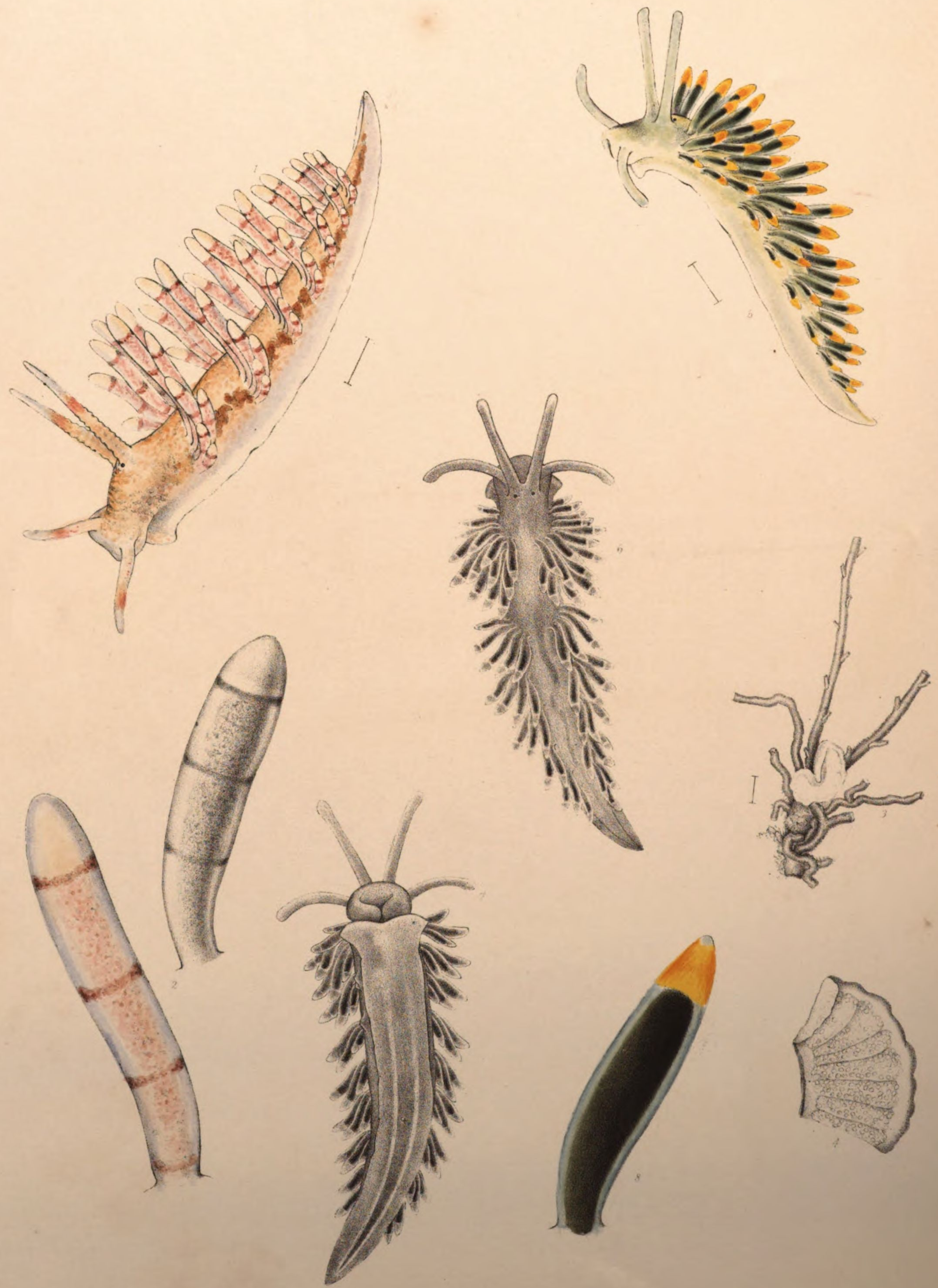
E. ovato-oblonga, sub-depressa, antica obtusa; lutescenti-viridis; branchiis sub-clavatis viridibus, in seriebus 9 digestis; tentaculis brevibus; angulis anterioribus pedis brevibus.

Eolis stipata, Ald. and Hanc., in Ann. Nat. Hist., v. 12, p. 233.
For. and Hanl., Brit. Moll., v. 3, p. 597.

Hab. On a Sertularia, dredged in Torbay, *J. A.*

Body a quarter of an inch long, rather depressed, broad in front and ending in an obtuse point behind, of a bright yellowish-green, paler towards the head. *Dorsal tentacles* rather short, subconical, smooth, of a greenish white, held nearly erect. *Oral tentacles* short and thickish, set wide apart on the head, which is broad and rounded in front. *Branchiæ* numerous, rather short, ovate-oblong or sub-clavate, stout, bright bluish-green, paler and yellowish towards the apex, arranged in nine or ten close transverse rows of eight papillæ each, nearly covering the back, and coming close to the dorsal tentacles in front: each row is set on a transverse ridge. *Foot* transparent white, rather broad, with the anterior angles not much produced.

An individual of this interesting species was obtained by the dredge at Torquay, in September, 1842. It lived only a very short time after its capture, so that a single sketch only could be taken of it.



J Alder & A Hancock del

W Wing lith Bacl & West Imp

Fig 1_4 EOLIS VITTATA Fig 5_8 EOLIS CLOTTENSIS

Fam. 3, Plate 29.

Figs. 1 *to* 4.

EOLIS VITTATA, Alder and Hancock.

E. gracilis, fulva, maculis ferruginosis; branchiis elongatis, sub-clavatis, pallidè fulvis vel carneis, cingulis 3 fuscis obscuris, apicibus flavidis, in seriebus 6-7 digestis; tentaculis fulvo-annulatis, apicibus albidis; angulis anterioribus pedis obtusis.

Eolis vittata, Ald. and Hanc., in Ann. Nat. Hist., v. 9, p. 35.

For. and Hanl., Brit. Moll., v. 3, p. 601.

Hab. On zoophytes from deep water, Cullercoats; rare.

Body nearly four tenths of an inch long, slender, buff or fawn-coloured, with darker spots and markings of the latter colour, especially on the head, and along the sides of the body at the bases of the branchiæ, where they form two broad interrupted lines. *Dorsal tentacles* rather long, linear, slightly wrinkled; fawn-coloured, with pale tips, and having a dull orange-coloured ring two thirds up; held nearly in an erect position. The eyes are placed at the base of these tentacles, but in front of them, and not behind, as usual. *Oral tentacles* shorter than the dorsal pair, coloured and banded in like manner, and inserted into the upper surface of the lip. *Head* rather large, and truncated in front. *Branchiæ* stout, long, and nearly linear, swelling a little towards the apex, which is obtuse: they stand very erect on the sides of the back, and radiate in the manner of the rays of a fan. They have the central gland of a rosy flesh-colour, delicately freckled and granulated with darker rose-colour. Each papilla has three brown bands, more or less distinct; that at the top being usually strongest, and forming a ring round the apex, which is pale yellow. The papillæ are arranged in eight or nine transverse rows, set considerably apart; there are from three to seven papillæ in each row. *Foot* transparent white; the angles obtuse and not much produced.

This beautiful animal has a considerable resemblance to *E. cingulata,* but the linear and subclavate branchiæ are sufficient to distinguish it. These never assume the ovate form of that species, even when contracted; their colour is also different. It may be remarked, too, that *E. vittata* carries the dorsal tentacles more erect than *E. cingulata.*

We have found three individuals of this species at different times on corallines brought in on the lines of the Cullercoats fishermen. They were all more or less injured, a circumstance unfortunately not uncommon, when these delicate and fragile creatures are obtained by that

means. The colour and markings vary a good deal. In one of the specimens the tentacles were without bands, the glands of the papillæ were scarcely visible, and their tips were without colour. The lateral markings were also broken up into freckles.

The spawn taken along with one of the specimens was in the form of a riband attached by one of its margins to the stem of a coralline, and, being coiled, assumed the shape of a cup: the eggs were arranged in wedge-shaped masses.

Fig. 1. *Eolis vittata,* side view.
2. Two of the branchial papillæ, much enlarged.
3. Spawn.
4. A portion of the same, much enlarged, exhibiting imbedded ova.

Figs. 5 *to* 8.

EOLIS GLOTTENSIS, Alder and Hancock.

E. gracilis, viridi-lutescens; branchiis robustis, atro-viridibus, apicibus aureis, in seriebus 8-9 digestis; tentaculis longis, obtusis; angulis anterioribus pedis rotundatis.

Eolis Glottensis, Ald. and Hanc., in Ann. Nat. Hist., v. 18, p. 293.

For. and Hanl., Brit. Moll., v. 3, p. 601.

Hab. Dredged in Lamlash Bay, Arran, on *Pecten opercularis, J. A.*

Body about four tenths of an inch in length, pale greenish-yellow; not very slender. *Dorsal tentacles* of the same colour as the body, transparent, with opaque white spots, rather long, linear, smooth, a little thickened at the top, and approximating at the base. *Oral tentacles* about two thirds the length of the dorsal pair, which they resemble in form and colour. They are set on the upper side of the lip, and are generally held in a curved position. Outline of the head semicircular. *Branchiæ* rather short and stout, the central gland of a dark bottle-green approaching to black above, granulated, nearly filling the sheaths; the apices are deep orange or golden-yellow, with sometimes a narrow yellow ring below; the extreme tips are transparent and rather blunt. They are arranged in eight or nine rows on each side of the back; the three front rows very close together; with a little space between them and the fourth. There are four or five papillæ in each row, excepting behind, where they diminish to two, coming very near to the tail. *Foot* transparent yellowish-white, with a deep notch in front, the angles slightly produced and rounded. It terminates posteriorly in a blunt point.

We procured a single specimen of this *Eolis* in June, 1846, while dredging, in company with our friends, the Rev. Dr. Landsborough and his son, in Lamlash Bay, Isle of Arran. From the heat of the weather at the time we were unable to keep it alive over the night.

Eolis Glottensis comes nearest to *E. arenicola* of Forbes, which it resembles a good deal in colour, but the proportions of the parts and number of branchiæ are so different that we think ourselves warranted in considering them distinct.

Figs. 5, 6, 7. *Eolis Glottensis*, different views.
8. One of the branchial papillæ, much enlarged.

A Reinecke del. W Wright lith.

Ford & Pitt Sc.

EOLIS VIRIDIS

EOLIS VIRIDIS, Forbes.

E. gracilis, viridi-albida; branchiis linearibus, acutis, viridibus, apicibus albis, seriebus 10 subremotis digestis; tentaculis linearibus, lævibus, æqualibus; lateribus anterioribus pedis subproductis.

Montagua viridis, Forbes, in Ann. Nat. Hist., v. 5, p. 106, pl. 2, f. 18.

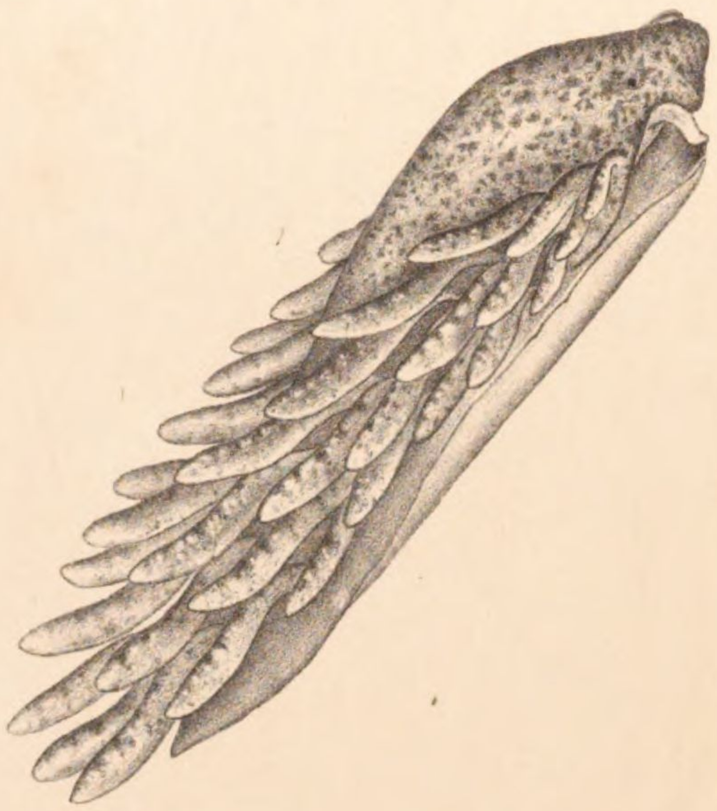
Eolis viridis, For. and Hanl., Brit. Moll., v. 3, p. 603, pl. BBB, f. 3.

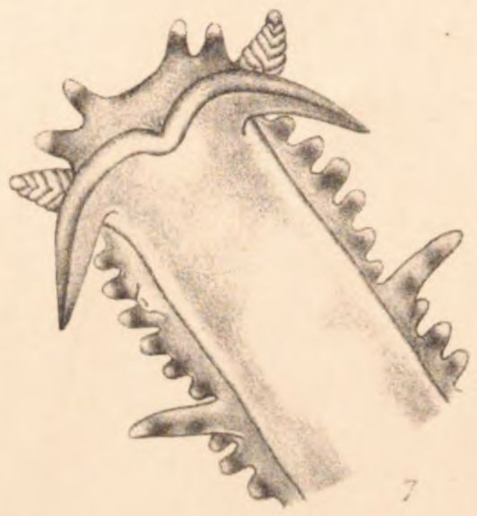
Hab. In twenty fathoms water, Isle of Man, and twenty-five fathoms, Cornwall, *Professor E. Forbes*. Saltcoats, and Portincross, Ayrshire, *Rev. D. Landsborough, jun.*

Body three tenths of an inch long, slender, white tinged with yellowish-green. *Dorsal tentacles* rather long, linear, smooth, greenish white. Eyes very conspicuous at their posterior base. *Oral tentacles* linear, about the same length as the dorsal pair, set on the upper surface of the lip; ends blunt. *Branchiæ* nearly linear, rather stout, somewhat abruptly pointed; the central gland of a bright bluish-green, varying to grass-green and bottle-green, and always much and strongly spotted with darker granules; the sheath is much wider than the gland, and the surface is sprinkled with opaque white spots, most numerous down the front; the apices are opaque white, apparently from the opacity of the ovate vesicle, which is very large, and not, as usual, from a white ring on the surface. The papillæ are set in ten rather distant rows, the four anterior rows being a little closer than the rest, and the first approaching to the sides of the dorsal tentacles. The rows contain from four to seven papillæ each, diminishing in size as they approach the foot. *Foot* yellowish white, slightly indented in front, a little produced and obtuse at the sides, tapering to a point behind a little beyond the branchiæ.

Eolis viridis was first obtained by Professor E. Forbes on an *Antennularia* dredged in deep water off Ballaugh, Isle of Man, and the same distinguished naturalist has since met with it on the coast of Cornwall. We have had it twice sent to us alive by the Rev. David Lansborough, jun., from the Ayrshire coast, where it was found at low-water mark. A specimen, which spawned with us in April, 1847, shows the spawn to be of a flattened form, attached by one of its edges, and forming a coil of nearly two volutions. The eggs are pale yellow, and are promiscuously scattered through the gelatinous envelope.

Figs. 1, 2, 3. *Eolis viridis*, different views.
4. Two of the branchial papillæ much enlarged.
5. Spawn.





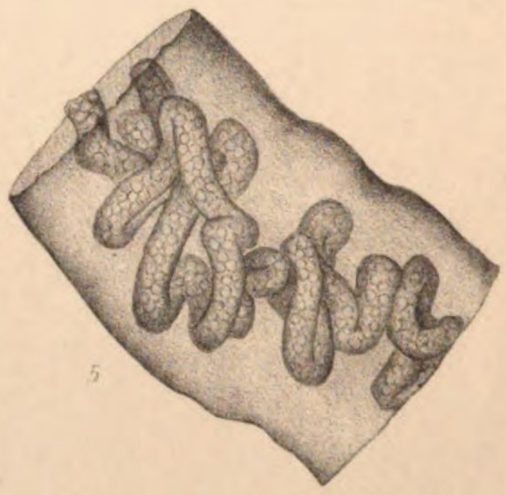


Fig 1–5 ALDERIA MODESTA Fig 6–7 LOMANOTUS FLAVIDUS.

Fam. 3, Plate 41.

Figs. 1 *to* 5.

ALDERIA MODESTA, Lovén.

A. ovata sub-convexa, lutescens, fusco variegata; capite parvo; branchiis elliptico-oblongis, postice crescentibus; in seriebus 6-7 digestis; pede amplo, lateribus reflexis.

Stiliger modestus, Lovén, in Ofv. Kongl. Vetens. Akad. Förh., 1844, p. 49.

Alderia amphibia, Allman, in Brit. Assoc. Rep. for 1844.

modesta, Idem., in Ann. Nat. Hist., v. 17, p. 5.

Lovén, Index Moll. Scand., p. 8.

S. Bate, Notes Faun. Swans., p. 6, pl. 1, f. 1, 2.

For. and Hanl., Brit. Moll., v. 3, p. 611, pl. c.c.c., f. 1.

Hab. In salt marshes and shallow pools of salt or brackish water, on a muddy bottom. Near Skibbereen, county Cork, *Professor Allman.* Loughor Marsh, near Swansea, *M. Moggridge, Esq.* and *C. Spence Bate, Esq.*

Body about half an inch long, ovate, rather convex, pale yellow, varying from greenish yellow to yellowish fawn-colour, and often densely spotted with dark brownish-gray. *Head* very small, slightly notched in front, and produced at the sides into obtuse lobes. *Branchiæ* ovate oblong, obtusely pointed, yellowish, frequently blotched with dark gray, especially in front, and spotted with opaque white: the tips white. The papillæ are disposed in six or seven diagonal rows on the sides of the back, commencing at some distance from the head, and leaving all the front of the back bare, but approaching more nearly behind. They increase in size towards the central and posterior rows, the last extending beyond the tail. *Foot* very large, rounded before and behind; produced and turned upwards at the sides: it is of a deep yellow in the centre becoming paler towards the edges.

In the autumn of 1842, Professor Allman met with this curious little mollusk in great numbers in a salt marsh near Skibbereen, which was never, except at the highest spring tides, flooded by the sea. The following interesting account of it was published by him in the Annals of Natural History.* "The day was bright and warm when I met with this curious little animal. Many had crept quite out of the water and were crawling over the moist fronds of *Enteromorpha intestinalis,* and seemed to delight in exposing their slimy bodies to the influence of the warm autumnal sun. Others swarmed on the mud in the little shallow pools of the marsh, when their ova were abundantly deposited in the usual gelatinous masses,

* Vol. xvii, p. 1.

characteristic of the eggs of the nudibranchiate gasteropods, a fact which is of itself sufficient to prove that this strange semi-marine and even semi-aqueous habitat was quite natural to our little nudibranch. Their bodies were enveloped in an exceedingly abundant mucous secretion, which was poured out more copiously than I recollect to have witnessed in almost any other gasteropod, and which is perhaps in some way connected with their singular, almost amphibious habits." This species was again met with, in the same locality, in September, 1846, and Dr. Allman kindly forwarded specimens to us, which, though they unfortunately did not reach us alive, were sufficiently fresh to enable us to make drawings of them in their natural colours. The *Alderia* has since been met with in Loughor Marsh, near Swansea, where it was found by Mr. Moggridge and Mr. C. Spence Bate in 1850. The latter gentleman states* that it was "first detected by Mr. Moggridge in the month of May, when it was on confervæ floating in the centre of a ditch made brackish by the occasional admission of sea-water. Later in the year, fructification having been completed, we found the animals crawling on the sides of the bank." From this locality we have been also kindly favoured with specimens.

The spawn of this little animal is very peculiar. The gelatinous envelope is rather broad and irregularly semicircular, but the chain of ova within is convoluted in a very curious manner, forming alternate loops on each side. This arrangement may be more readily understood by a reference to our figures than by description.

The species extends to Norway, where it was discovered by Professor Lovén.

Our figures were taken from dead specimens in a fresh state, assisted by the drawings of M. Lovén and Mr. C. Spence Bate.

Figs. 1, 2. Side and back views of *Alderia modesta*.
3. Two of the branchial papillæ, much enlarged.
4. Spawn.
5. A portion of the same, more highly magnified.

---

* Notes on the Fauna of Swansea, p. 6.

Figs. 6 *and* 7.

LOMANOTUS FLAVIDUS, Alder and Hancock.

L. flavidus; velo parvo tuberculato; tentaculis clavatis, intra vaginas tuberculatas retractilibus; branchiis parvis, papillosis, fulvo-cinctis, ad latera dorsi utrinque in serie unicâ dispositis.

Eumenis flavida, Ald. and Hanc., in Ann. Nat. Hist., v. 18, p. 293.

Lomanotus flavidus, For. and Hanl., Brit. Moll., v. 3, p. 586.

Hab. Dredged in Lamlash Bay, Isle of Arran, *J. A.*

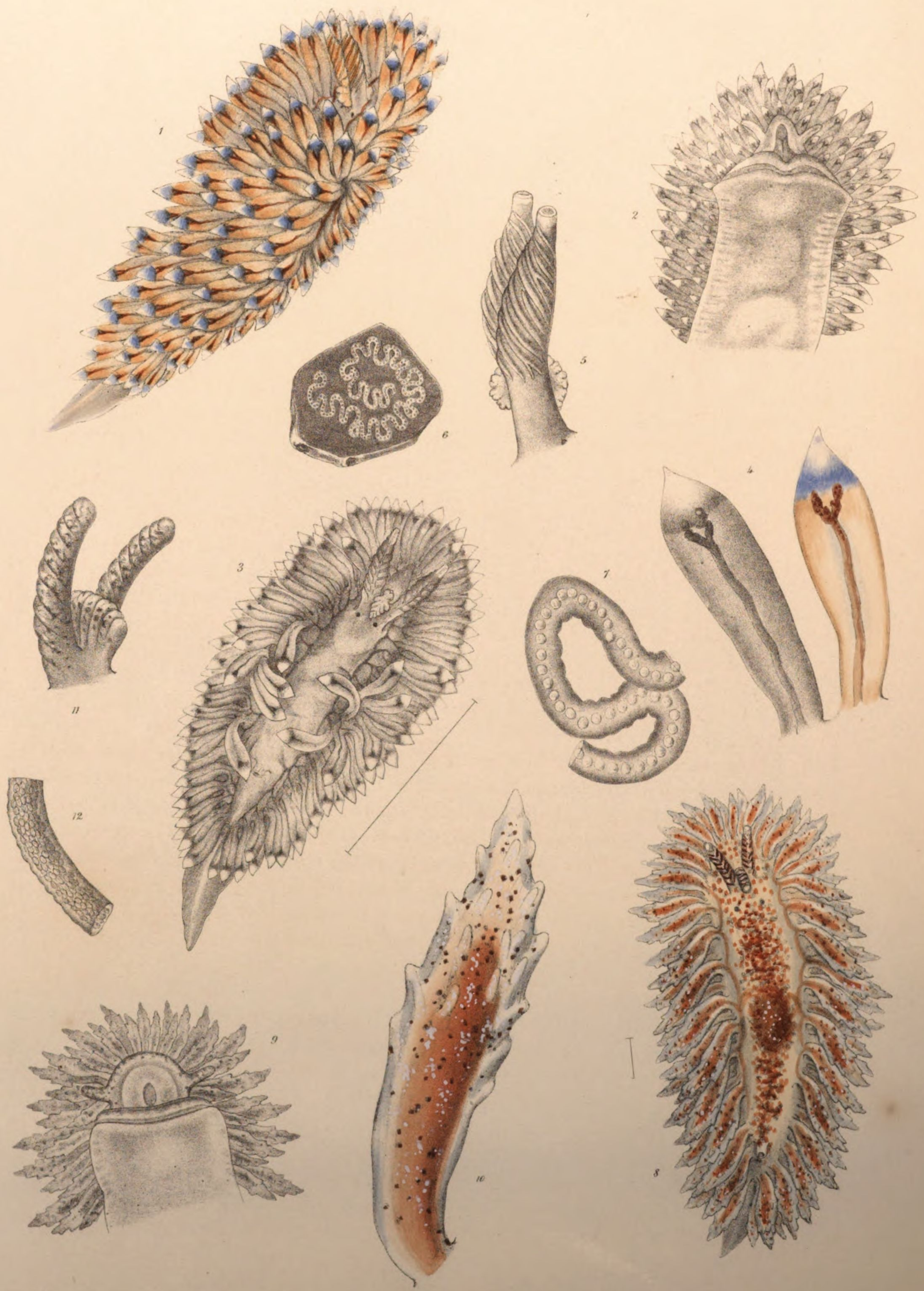
Body a quarter of an inch long, quadrilateral, lemon-coloured above, white beneath. *Dorsal tentacles* clavate, laminated, pale yellowish white, the sheaths set round the top with about six tubercles, the outer ones largest, each having a ring of fawn-colour. *Veil* very small, with four tubercular points. *Branchiæ* papillose, mostly very short, but three on each side, set at regular intervals, are larger than the rest and nearly linear; each papilla is encircled by a band of fawn-colour, one or two of the larger ones having a faint indication of a second band below. They are set on a slightly waved pallial ridge, commencing at the sides of the veil in front and reaching nearly to the tail. The sides of the body are white, with a few pale yellow markings. *Foot* nearly linear, transparent white, slightly tinted with purple-brown at the edges; the front is strongly grooved transversely, notched in the centre, and produced into long tentacular points at the sides.

The interest attached to this little mollusk on account of its shewing a modification of form in a very rare genus, induces us to give figures of it, although we are obliged to place them out of the regular order.

Only three species of *Lomanotus* have yet been discovered. In *L. Genei,* of Verany, a species nearly two inches and a half long, the branchiæ form foliaceous expansions of the pallial ridge: in our *L. marmoratus* the same character is apparent; but in the present species the pallial margin is very indistinct and the branchiæ begin to assume the form of regular papillæ, indicating a nearer approach to the typical forms of the family *Eolididæ.*

We obtained the only known example of this species on a small *Antennularia* brought up by the dredge from three or four fathoms water, in Lamlash Bay. Unfortunately, it was a little injured, and did not long survive.

Fig. 6. *Lomanotus flavidus,* back view.
7. Anterior portion of the under side.



J. Alder and A. Hancock del.

W. Wing lith. Bird & West Imp.

Fig 1_7 ANTIOPA CRISTATA Fig 8_12 ANTIOPA HYALINA

Fam. 3, Plate 44.

Figs. 1 *to* 8.

ANTIOPA CRISTATA, Delle Chiaji, Sp.

A. ovata, postice attenuata, pallidè fulva, pellucida; branchiis numerosis, ovato-oblongis, inflatis apicibus opacis, cæruleis, glandulâ centrali brunneâ, lineari, supernè furcatâ; tentaculis dorsalibus subconicis, valdè laminatis; tentaculis labialibus parvis linearibus.

Eolis cristata, Del. Chia., Desc. Stor. Anim. Nap., pl. 88.

Janus Spinolæ, Verany, Catal. Inv. Genova, p. 24, pl. 2, f. 9.

Blanchard, in Ann. des Scien. Nat., 3me Ser., v. 11, p. 77.

Antiopa splendida, Ald. and Hanc., in Ann. Nat. Hist., 2d Ser., v. 1, p. 190.

Spence Bate, Notes Faun. Swans., p. 7, pl. 2.

For. and Hanl., Brit. Moll., v. 3, p. 609, pl. B. B. B., f. 6.

Hab. Torbay, *Dr. Battersby.* Fowey Harbour, Cornwall, *J. A.* Langland Bay, South Wales, *M. Moggridge, Esq.* Barricane, near Ilfracombe, *P. H. Gosse, Esq.* Menai Straits, *J. A.*

Body about an inch and a half in length, ovate, rather depressed, and tapering to a fine point behind, of a delicate lemon-yellow inclining to buff or fawn-colour, very transparent, sometimes nearly white. *Dorsal tentacles* conical, a little bent in front, and truncated at the top, yellow with white tips. They are strongly laminated in an oblique direction, the laminæ uniting in a ridge behind. The tentacles are united at the base, for about a quarter of their height, by an arched crest of a semicircular form, a good deal sinuated and lobed, narrow on the top, and spreading out before and behind; the sides shew a radiating structure. *Oral tentacles* short and linear, set on the sides of the head, which is of a conical form, the lips overhanging the mouth like a hood. *Branchiæ* very numerous, ovate-oblong, rather abruptly pointed. They are capable of great inflation, and are of the same colour as the body, and very transparent, shewing a narrow, brown, central gland, which is bifurcated and sacculated at the top. The apices are opaque bluish white, deepening into ultramarine blue, and have a brilliant metallic lustre. The papillæ are thickly set on the sides of the back and round the head in front, on a pallial ridge, without apparent order, meeting posteriorly a little behind the tubular anus, from whence a line of white runs down to the tail. The papillæ near the foot are small and much crowded; those towards the centre of the back are large, and when the animal is crawling, nearly conceal the whole of the body. The back is generally blotched and spotted with bluish white, having the same metallic lustre as the tips of the papillæ. The gastro-hepatic vessels are very distinctly seen through the skin, forming two brown lines down the sides of the back, with ramifications running into the papillæ. *Foot* rather broad, thin at the edges, and deeply grooved in front, so as to form two distinct laminæ; the upper one of which is strongly notched in the centre; the lower rather less so; it is a little convex in

outline, terminating at the sides in obtuse angles scarcely produced. The colour is transparent white or yellowish.

This splendid animal was dredged in Torbay, by Dr. Battersby, whence it was sent us through the kindness of Mrs. Griffiths. We have since met with it in Cornwall and North Wales, and Mr. Moggridge and Mr. Gosse have each obtained a specimen on the shores of the Bristol Channel. It appears, therefore, to be pretty generally diffused on the south-western shores of our island. It is one of the few species we possess common to England and the Mediterranean, and is probably a southern form that here reaches its northern limits, as in the Mediterranean, where it is more common than with us, it attains a larger size. The specimens we dredged in the Menai Straits, were scarcely more than half the size of those on the southern coast.

This is a very active animal, moving about with great grace and elegance. The branchial papillæ are then in constant motion, and when seen on a dark ground, their brilliant tips stand out conspicuously, and appear like a cluster of gems. We have observed an aperture at the end of each papilla, visible with a common pocket lens, which, when the animal is in a lively state, is frequently opened and closed alternately: when open, the apex assumes a rounded outline, but it terminates in a sharp point when the aperture is closed: the latter is the usual form when the animal is at rest. This action is probably connected with the discharge of urticating filaments, as in the *Eolides*, but we could not detect anything issuing from the aperture at the time.

The spawn of this species, for a drawing and description of which we are indebted to Mr. Gosse, presents some peculiar features. It consists of a transparent gelatinous thread, deposited in tortuous undulations, which Mr. Gosse aptly compares to a succession of figures of 8. These are arranged in the usual spiral form. The ova are in single series, and are transparent globules, appearing at first about two thirds filled with opaque white specks, in the form of a crescent. "About five days after deposition," Mr. Gosse informs us, "the white specks in the globules had filled the whole interior," and on examination under a microscope, "each globule was seen to be a chorion of gelatinous membrane containing more than sixty active little nautiloids." Usually the ova of the Nudibranchs are crowded together in numerous rows throughout the gelatinous envelope, each egg having a single embryo, or at most three or four. Here, however, there is only a single row of eggs, but the apparent deficiency of numbers is made up by each egg containing numerous embryos: the whole amounting, according to Mr. Gosse's calculation, to 45,000.*

Fig. 1, 3. Side and back views of *Antiopa cristata*.
2. Under side of the anterior portion of the same.
4. Two of the papillæ.
5. Dorsal tentacles with crest.
6. Spawn.
7. A portion of the spawn enlarged, shewing the arrangement of the eggs.

* See 'A Naturalist's Rambles on the Devonshire Coast,' p. 325.

Fam. 3, Plate 44.

Figs. 8 *to* 12.

ANTIOPA HYALINA, Alder and Hancock.

A. elliptica, postice attenuata, pellucida, pallidè lutescens, rufescenti-fulvo longitudinaliter in medio dorso notata; branchiis ellipticis, tuberculatis, hyalinis, glandulâ centrali fulvâ, lineari; tentaculis dorsalibus linearibus, obtusis, obscurè laminatis; velo capitali arcto, tentaculis 2 brevibus instructo.

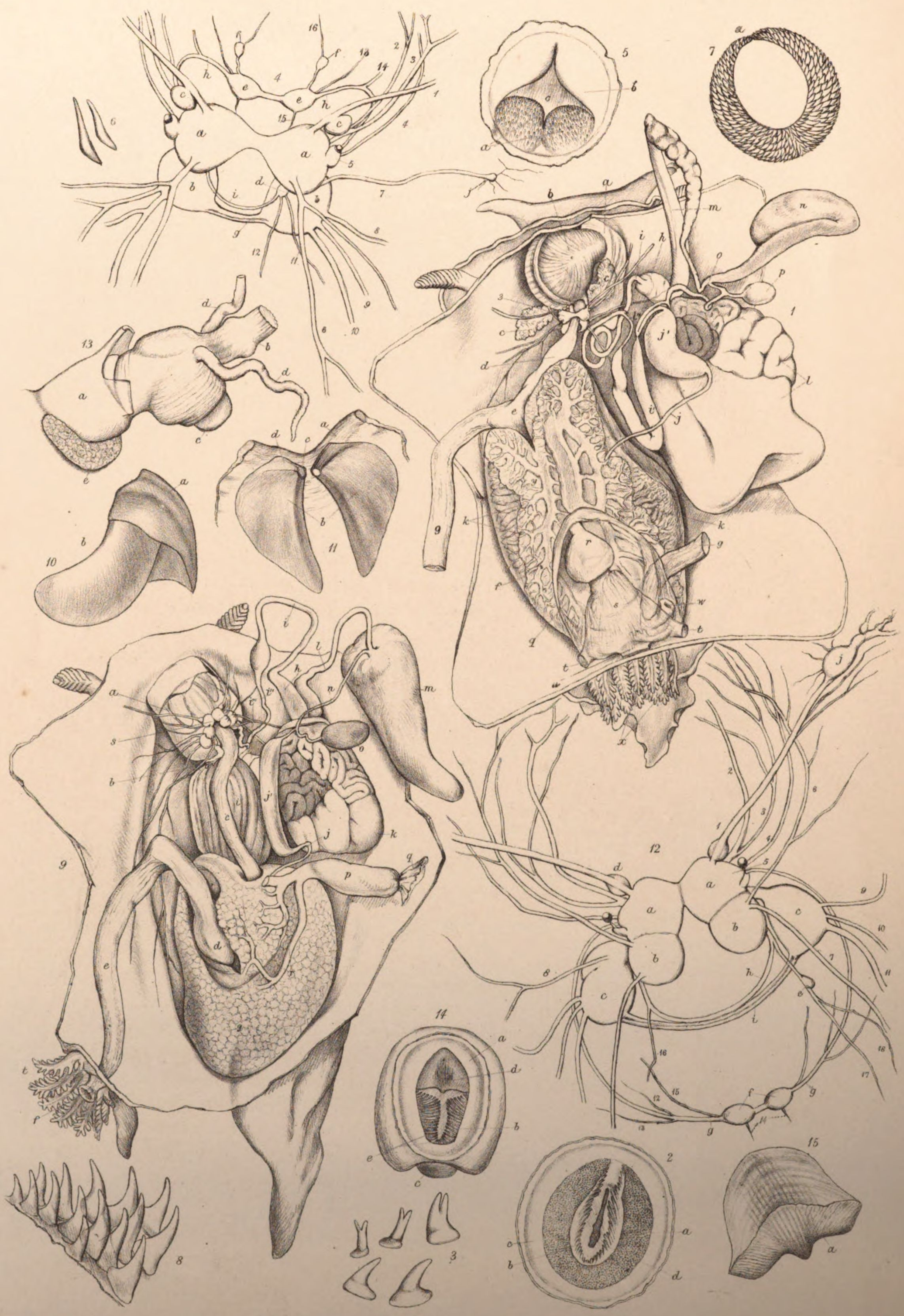
Hab. Hilbro Island, mouth of the Dee, Cheshire, *J. Byerley, Esq.*

Body three tenths of an inch in length, elliptic-oblong, very transparent, yellowish, with reddish brown markings. *Dorsal tentacles* rather short, linear, a little curved backwards, obtuse and rounded above, with about ten oblique rather obscure laminæ, reaching very close to the apex; yellowish fawn-coloured, spotted with brown and white. They are united at the base by a semicircular crest of the same colour, with transverse lobules, giving it a radiated structure at the sides. The crest rises to about one third the height of the tentacles. *Oral tentacles* very short, linear-conical, set on a narrow semicircular veil that surrounds the head. Back pale transparent yellow, thickly spotted and blotched down the centre with bright reddish brown. *Branchiæ* numerous, elliptic-oblong, tapering to a blunt point, and tuberculated or mucronated on the upper part. They are of a hyaline transparency, showing a rather stout fawn-coloured central vessel, reaching about two thirds up. The surface is spotted with brown and opaque white, with blotches of the latter on the tubercles. The branchiæ are densely arranged on a pallial ridge down the sides of the body, and round the head, without forming regular rows. They meet behind the anus, concealing the posterior extremity. *Foot* strongly grooved in front, with the lateral angles rounded. It tapers to a point behind.

This interesting mollusk was obtained by Mr. Byerley when dredging at the mouth of the Dee in the summer of 1851. Though a true *Antiopa*, from the laminated tentacles and dorsal crest, this animal shows a very close approach to *Proctonotus mucroniferus* in the tuberculated branchiæ and small frontal veil. Its colour, too, reminds one a good deal of that single known species of *Proctonotus*. Reviewing the two genera again, since the acquisition of this species, we find no character to distinguish them from each other but the dorsal crest, and laminated or unlaminated tentacles. The former feature, however, is so peculiar that we still feel ourselves justified in keeping them apart.

The spawn forms a cylindrical cord, loosely convoluted like that of *Dendronotus*. The ova are white, without particular arrangement, and almost filling the gelatinous envelope.

Fig. 8. Back view of *Antiopa hyalina*.
9. Under side of the anterior portion of the same.
10. A papilla much enlarged.
11. Dorsal tentacles with crest.
12. A portion of the spawn.



A.Hancock, del. W.Wing lith.

Ford & West. Imp.

ANATOMY OF GONIODORIS. &c.

Genus 2. GONIODORIS,* Forbes.

Corpus limaciforme, subangulatum, posticè acuminatum, pallio parvo marginibus reflexis pæne obtectum. *Caput* ultra pallium prominens, in tentacula 2 labialia complanata extensum. *Tentacula dorsalia* 2, laminata, non retractilia. Branchiæ plumosæ, non retractiles, postice in lineâ mediâ dorsi anum circumdantes. Apertura genitalis ad latus dextrum.

This genus has been very properly separated from *Doris* by Professor Edward Forbes, who described it in the 'Annals of Natural History,' for March 1840.† It is distinguished from *Doris* by the small cloak, the more angular body, and the tapering form of the posterior extremity. To these characters we have added the exposure of the head beyond the cloak in front, and the non-retractibility of the dorsal tentacles and branchial plumes.

The additional characters we consider necessary for the more accurate definition of the genus, though by thus restricting it, we exclude a beautiful group of the *Doridideæ*, with a small cloak, peculiar to warmer climates, and distinguished by the brilliancy of their colours, which are generally disposed in stripes, spots, or marginal bands. In this group, which it was the original intention of Professor Forbes to include in his genus, the cloak, though small and narrow, is advanced before the head, and the dorsal tentacles are retractile within cavities; the body also has a more bi-lamellar form. The group in question appears to us to constitute a well-marked genus, distinct from *Goniodoris*, from which we have consequently excluded it. *Goniodoris*, as now restricted, contains a very limited number of species, confined, so far as we at present know, to European seas. Herrmannsen erroneously states that the type of this genus is the *Doris gracilis* of Rapp, a Mediterranean species, of deep blue colour with white stripes, belonging to the southern group already mentioned. The true type of *Goniodoris* we take to be the *Doris nodosa* of Montagu, of which the *Goniodoris emarginata*, described by Professor Forbes in the paper where he characterises the genus, is a variety.

This genus has the body of a sub-quadrilateral form, with elevated sides and tapering posteriorly to a pointed tail. The cloak is small with a waved margin, generally reflected, and is truncated or sinuated posteriorly immediately behind the vent. A median ridge, sometimes not very distinctly marked, on the cloak, is continued conspicuously to the tail. The head extends beyond the cloak in front, and is covered by a subvelar expansion, which is produced into flattened oral tentacles at the sides. The mouth is inferior, without corneous jaws, but with a spinous prehensile collar, and a denticulated tongue. The dorsal tentacles are clavate and laminated, and are non-retractile. The branchiæ are plumose, and surround

* From γωνια, an angle, and *Doris*. † Vol. 5.

the vent on the median line about two thirds down the back. They, like the tentacles, are non-retractile and are without lateral appendages. The foot is rather large, rounded in front, and produced into a point behind. The generative organs have a single aperture, which is situated on the right side, a little behind the dorsal tentacles.

In its internal structure *Goniodoris* is not very dissimilar from *Doris*. The mouth opens on the inferior surface of the head, whence a short channel leads into the buccal organ (Pl. 17, fig. 1 *a*), which, though not very large, is muscular, and has appended to its upper surface a spherical gizzard (*b*), with radiating muscles, similar to that in *Doris bilamellata* and others. The tongue is narrow, and composed of numerous rows of four plates each; the two plates next the median line bearing large curved spines with denticulated margins in *G. nodosa:* in *G. castanea* the margins are plain. There is no central spine or plate. Not more than half of the tongue is brought into action at a time, the posterior portion being tubular and placed in a sheath which extends from behind the buccal organ: here the spines are generated, as in *Doris*. The buccal lip is provided with a prehensile collar (fig. 2 *a*), interrupted above, and crowded with numerous, minute, bifid spines (fig. 3).

The œsophagus (fig. 1 *d*), which is rather long and slender, passes from the upper aspect of the buccal organ just behind the gizzard, and, after passing through the nervous collar, is slightly dilated in *G. nodosa*, but in *G. castanea* is of equal caliber throughout. Two short, folliculated salivary glands (*c, c*) open into the buccal cavity, one on each side of the œsophagus. The stomach (*e*) is small, of an irregular form, situated in a shallow cleft in the anterior border of the liver. The œsophagus enters it in front, and the intestine (*g*), which is a simple tube of no great diameter, passes off from the upper aspect, and crossing the upper surface of the liver, dips down on the right side on its way to the anal nipple, situated in the centre of the branchial circle. The biliary secretion enters the digestive cavity by two or three large orifices near to the œsophageal opening. No pancreatic organ has been observed. The liver (*f*) is a large oval mass, filling up the posterior portion of the visceral cavity, and having a shallow cleft in front for the reception of the stomach; it is granular and of the usual dark brown colour.

The reproductive organs are constructed on the same plan as in *Doris*, but show some interesting modifications of the component parts. The testis is divided into three well-marked portions;—next the intromittent organ (*h*), it is stout and tubular (*i*); some distance backwards it suddenly contracts and becomes minute and duct-like (*i″*); this second portion leads to one extremity of a fusiform, glandular body (*i′*), which is doubled upon itself, and has the other extremity opening into the oviduct. The second portion seems deficient in *G. castanea*. The gland-like portion of the testis has some similarity to that described in *Doris coccinea*. The ovary (*k, k*) is spread over the upper surface of the liver, and presents a decidedly dendritic structure, crowded exteriorly with numerous ovigerous follicles. The oviduct is at first very slender (*j*), but, suddenly dilating, becomes excessively wide, and as it advances to the anterior margin of the mucus-gland it is reduced at once to its original caliber before receiving the extremity of the testis; it shortly afterwards receives the duct (*o*) from the spermathecæ and thence dips down into the mucus-gland. The vaginal tube (*m*), is rather wide and long; it is doubled upon itself, and before reaching the spermatheca is much attenuated. There are two spermathecæ, one very large (*n*), the other small (*p*), the former is long and pyriform, the latter elliptical. The mucus-gland (*l*) does not differ materially from

that of *Doris*. In *G. castanea* the vaginal tube is very much shorter than in *G. nodosa*, and can scarcely be said to be doubled upon itself; the large spermatheca is elliptical, and is also much smaller than in the other species.

The vascular and respiratory system, so far as we have been able to ascertain, are in the same condition as in *Doris*. The heart rests on the upper surface of the liver, and is contained in a well-defined pericardium (*q*). The auricle (*s*), receives the blood by two lateral vessels (*t, t*), from the skin, and by a posterior median one (*u*), from the gills; that is, in this way it is returned from the general system and from the liver mass: it is then passed into the ventricle (*r*), and is distributed to the various organs by arteries, which branch from a large trunk that issues, in the usual manner, from the anterior apex of the propelling organ. The portal heart (*w*), is distinctly seen lying below the pericardium, into which it opens, and its vascular trunk can be traced into the renal organ. From these facts, it is evident that here, as in *Doris*, the blood is returned to the heart only partially aerated, and that the systemic circulation is twofold,—general and partial; the latter comprising a portal circulation.

The renal organ (*y*) covers the greater portion of the upper surface of the liver, lying immediately above the ovary, and resembles the same organ in *Doris pilosa*. Its margins are somewhat sinuous, and the inner surface of the circumscribing membrane is richly supplied with a vascular net-work, with which the twigs from the trunk given off by the portal heart go to inosculate. The renal orifice opens externally, close to the base of the anal nipple, in front and to the right side.

The nervous system is highly concentrated in this genus. There are four principal œsophageal ganglia, and four buccal; of the former, two are above, and two at the side of the alimentary tube; those above are broadly ovate, with their sharper ends placed towards the median line, across which they are united. These ganglionic masses (fig. 4 *a, a*) are composed of the cerebroid and branchial ganglia, completely fused; and give off, from the upper surface of the frontal margin two large nerves (1), which go to the dorsal tentacles: these have attached to them, at their origin, the olfactory ganglia (*c, c*), which are round, and almost as large as the buccal ganglia. Three other pairs of nerves (2, 3, 4) pass from the under surface in front, and go to the channel of the mouth and lips; the largest of these (3) gives a stout branch to the oral tentacles. From behind,—the branchial portion,—a larger nerve (6) is given off from each mass, and goes to supply the dorsal skin or mantle.

The pedial or lateral ganglia (6, 6) are closely united to the under surface of the upper pair, and are joined below the œsophagus by a short, stout, commissural cord (*g*), the great œsophageal collar, composed of two filaments—one being much finer than the other. These ganglia furnish each two or three nerves to the foot.

A small visceral ganglion (*d*) is attached to the under surface of the right upper ganglionic mass behind; consequently to the branchial portion of it. It gives off two or three nerves (11, 12), which go to the viscera. A commissural cord (*i*), also comes off from this ganglion, and passing under the alimentary tube, in conjunction with the great œsophageal or pedial collar, goes to the branchial portion of the opposite ganglion. There is also another nerve from the œsophageal ganglia; this (7) comes from the right upper ganglion, close to the visceral, and may possibly belong to it. This nerve goes to one or two small ganglia (*j*), on the root of the penis.

The eyes, which are as well developed as in *Doris*, are fixed on small roundish ganglia

(5), which are sessile on the outer margin above, of the cerebroid portion of the upper ganglia. The auditory capsules contain numerous otolithes, and are seated upon the under surface of the upper ganglia, near to their junction with the pedial.

The buccal ganglia (*e, e*) occupy their usual position on the buccal mass, immediately behind the œsophagus: they are elliptical, are united across the median line by a longer commissure than usual, and are joined to the upper ganglia by two fine cords (*h, h*). These ganglia give nerves to the tongue (15), and buccal organ (13, 14), and have attached to them by longish pedicles a pair of gastro-œsophageal ganglia, (*f,f*), which send two nerves (16) down the œsophagus, and also supply the salivary glands.

The only traces that we have detected of a sympathetic system are the œsophageal nerves, and the small ganglia, and some minute nerves on the root of the intromittent organ.

The skin is soft and more or less tuberculated; and though well supplied with spicula, they are not sufficiently numerous to stiffen the surface.

EXPLANATION OF THE PLATE.

Fig. 1. General view of the viscera of *Goniodoris nodosa*, partially spread out and seen from above:—*a*, buccal mass; *b*, buccal gizzard; *c, c*, salivary glands; *d*, œsophagus; *e*, upper portion of stomach; *f*, liver mass; *g, g*, intestine; *h*, retracted penis; *i*, tubular portion of testis; *i′*, glandular portion of the same; *i″*, small tubular or duct-like portion of the same; *j*, portion of oviduct as it leaves the ovary; *j′*, dilated portion of the same; *k, k*, ovary overlying the liver; *l*, mucus-gland of female organs; *m*, vaginal tube, leading from the exterior to the spermatheca; *n*, spermatheca; *o*, tube leading from the same to the oviduct; *p*, accessory spermatheca; *q*, pericardium; *r*, ventricle, seen through the transparent walls of the pericardium; *s*, auricle; *t, t*, lateral trunk-veins from mantle to auricle; *u*, branchio-cardiac vein; *w*, portal heart, seen through the transparent membranes of the heart; *x*, branchial plumes; *y*, renal organ; *z*, cerebral ganglions.

2. Front view of the prehensile collar of *Goniodoris nodosa*:—*a*, collar; *b*, membranous fringe attached to the inner margin of the same; *c*, buccal lip; *d*, buccal orifice.
3. A few of the spines from the prehensile collar of *Goniodoris nodosa*.
4. Cerebral ganglions of *Goniodoris nodosa*:—*a, a*, cerebroid and branchial ganglions fused into two masses; *b, b*, pedial; *c, c*, olfactory; *d*, visceral; *e, e*, buccal; *f,f*, gastro-œsophageal; *g*, great œsophageal collar; *h, h*, nervous cords connecting the buccal ganglions to the cerebroids; *i*, small collar uniting the branchial and visceral ganglions; 1, olfactory nerves; 2, nerves supplying the upper portion of the channel of the mouth; 3, those to the side of the oral channel and oral tentacles; 4, those to the under side of the channel of the mouth; 5, eyes, each seated on a small ganglion; 6, pallial nerves; 7, a nerve which goes to a small ganglion (*j*) seated on the root of the male intromittent organ; 8, 9, 10, pedial nerves; 11, 12, visceral nerves; 13, 14, buccal nerves; 15, lingual nerves; 16, œsophageal nerves.
5. Front view of the rudimentary prehensile collar of *Idalia pulchella*:—*a*, spinous lobes; *b*, buccal lip; *c*, oral opening.
6. Two spines from the same highly magnified.
7. Front view of prehensile collar of *Ancula cristata*:—*a*, upper margin.
8. A few of the spines from the same much enlarged.

GONIODORIS.

Fig. 9. General view of the viscera of *Polycera quadrilineata*, the dorsal skin being laid open and the various organs a little separated:—*a*, buccal mass; *b*, salivary glands; *c*, œsophagus; *d*, upper wall of stomach; *e*, intestine; *f*, vent; *g*, liver mass enveloped in the ovary; *h*, retracted penis; *i*, glandular portion of testis; *i′*, tubular portion of the same; *i″*, constricted tubular portion; *i‴*, short tube uniting the glandular portion to the oviduct; *j*, oviduct as it leaves the ovary; *j′*, dilated portion of the same; *k*, mucus-gland in connexion with female parts; *l*, vaginal tube leading from the exterior of the spermatheca; *m*, spermatheca; *n*, tube from the same to the oviduct; *o*, accessory spermatheca; *p*, ventricle of the heart, turned forward; *q*, a portion of the auricle; *r*, arterial trunks; *s*, cerebral ganglia; *t*, branchial plumes.

10. External view of one of the jaws of *Polycera quadrilineata*:—*a*, cutting edge; *b*, upper margin.

11. Jaws of *Polycera Lessonii*, as seen in the compressor of the microscope, the buccal mass laid open from below:—*a*, buccal lip; *b*, jaws; *c*, point of articulation; *d*, cutting edge.

12. Cerebral ganglions of *Polycera quadrilineata*:—*a*, *a*, cerebroid ganglions; *b*, *b*, branchial; *c*, *c*, pedial; *d*, olfactory; *e*, visceral; *f*, buccal; *g*, *g*, commissural cords connecting the buccal ganglions to the cerebroids; *h*, small collar uniting the branchial and visceral ganglions; *i*, great œsophageal collar; 1, olfactory nerves terminating in ganglionic enlargements (*j*) within the tentacles; 2, nerves to the oral tentacles; 3 and 4, those to the channel of the mouth; 5, optic nerves, each having at its origin a small ganglion; 6, nerves supplying tentacular filaments and dorsal skin in front; 7, pallial nerves; 8, a nerve to the skin on the side of the body; 9, 10, 11, pedial nerves; 12, 13, buccal nerves; 14, lingual nerves; 15, œsophageal nerves; 16, 17, 18 visceral nerves.

13. Buccal mass of *Ægirus punctilucens*, side view:—*a*, channel of the mouth; *b*, œsophagus; *c*, lingual sheath; *d*, *d*, salivary glands; *e*, glandular organ, supposed for secreting mucus to lubricate the foot.

14. Front view of buccal mass of the same, the channel of the mouth having been removed:—*a*, buccal lip; *b*, oral opening; *c*, lingual sheath; *d*, upper corneous jaw, or tooth; *e*, lateral membranous fringes.

15. Corneous jaw or tooth of *Ægirus punctilucens* removed from the buccal lip:—*a*, cutting edge with median denticle.

Genus 3. TRIOPA,* Johnston.

Corpus limaciforme, subdepressum, postice acuminatum, pallio parvo appendicibus linearibus marginato obtectum. *Caput* inferius, sub pallio absconditum, tentaculis 2 labialibus instructum. *Tentacula* dorsalia 2, laminata, intra vaginas retractilia. Branchiæ plumosæ, in lineâ mediâ dorsi anum præpositæ. Apertura genitalis ad latus dextrum.

The type of this genus is the *Doris clavigera* of Müller, a species long known to naturalists by the figures and description of that author, though their familiarity with the living mollusk is but of recent date.

It was raised to the rank of a genus, under the above name, by Dr. Johnston in his account of the 'Scottish Mollusca Nudibranchia,' published in the first volume of the 'Annals of Natural History' in 1838; but characterised rather loosely, in order, as the author informs us, to embrace another species, which, however, has turned out to belong to the genus *Polycera*. In redescribing it, we have, therefore, found it necessary to make a considerable alteration in the original generic character. In the first volume of the 'Enumeratio Molluscorum Siciliæ,' published in 1836, Dr. Philippi has described a genus under the name of *Euplocamus*, founded upon a Mediterranean species, differing only from this in the branched nature of the marginal appendages of the cloak, which he considers to be additional branchiæ, and in the absence of distinct oral tentacles. The genera are probably distinct; but however that may be, the name of *Triopa* must be retained, as that of *Euplocamus* had been previously used for a genus of insects. M. Philippi has since united his genus with the *Idalia* of Leuckart, a proceeding in the propriety of which we do not coincide.

The only two species of *Triopa* at present known are inhabitants of the seas of Northern Europe. Two species of *Euplocamus* are found in the Mediterranean. Yellow appears to be the predominant colour in all of them.

The form of the body, and the marginal processes of the cloak, in *Triopa*, indicate an approach to the *Tritoniadæ*, which is further carried out by these processes assuming a branched form in *Euplocamus*, having a considerable resemblance to the branchial tufts in *Tritonia*. And, assuming that the lateral processes are of a branchial nature, *Triopa* may be considered to make an approach to that section of the *Eolididæ*, which have a posterior dorsal anus (the *Proctonotinæ*), for in them the branchial papillæ pass round the front of the head in the same manner as the processes do in this genus. The head and oral tentacles have also some similarity to those of *Antiopa*. In its well defined cloak, rough with spicula and tubercles, *Triopa* shows, on the other hand, a near affinity to *Doris*. We have been chiefly influenced by the character of the lingual plates, and the disposition of the branchial plumes, in giving it a place amongst the *Polycerinæ*.

* The name of a son of Neptune.

TRIOPA.

The body of *Triopa* is elongated and rather depressed, tapering posteriorly. The cloak is small, exposing the foot, rounded and extended over the head anteriorly, and terminating in a point behind. Its margin is adorned with numerous linear, subclavate processes. The head is inferior, with two shortish labial tentacles: the mouth is not furnished with jaws. The two dorsal tentacles are laminated and retractile within small sheaths. The branchiæ are plumose, generally few in number, and placed immediately in front of the vent, partially surrounding it at the base, on the median line of the back. The foot is moderately sized, nearly linear, and deeply sinuated in front. The aperture of the genital organs is simple, situated on the right side about one third down the body.

Our observations on the anatomy of this genus must be confined to that of *T. claviger*, the only one we have had an opportunity of dissecting.

The buccal organ is rather small, and less muscular than usual; the channel leading to it from the external opening, which is situated on the under surface of the head, is very short: there are neither jaws nor prehensile collar, and the tongue is formed on the type of that of *Polycera*, but is somewhat broader; it is of a pale yellow colour, and is divided down the centre by a naked space: the tubular portion behind projects, slightly from the posterior end of the buccal organ. The plates are numerous and are arranged in about forty-five rows of twenty-two plates each; the ten external ones are much depressed, of a square form, and set close together; the two on each side of the median line bear large curved spines, the innermost being much attenuated, the other very stout and with a single denticle near the point.*

The œsophagus, which is of no great length, passes from the buccal organ above and behind, and has at its origin a pair of tubular salivary glands, which open into the mouth in the usual way. At first the alimentary tube is much constricted, but immediately on passing through the nervous collar, it is suddenly enlarged a little, and soon afterwards contracting slightly, is continued backwards, of equal caliber, to the anterior border of the liver, into which it plunges, the stomach being buried in that viscus. The intestine is short; it issues from the upper surface of the hepatic organ towards the left side, and, passing across towards the right, pursues its path, almost in a straight line, to the anus.

The reproductive organs are similar to those of *Ægirus*. The glandular portion of the testis and the spermathecæ are, however, somewhat modified in form. The oviduct too is rather peculiar: at first it is much attenuated and then, as usual, becomes suddenly and much enlarged; but afterwards contracts again at a considerable distance from its junction with the testis. The ovary covers the upper surface of the liver, giving to that organ a very distinct tesselated appearance: it is composed of a number of large globules surrounded by smaller ones; the latter are yellowish, and contain ova; the former are pale in colour, and filled with spermatozoa.

The vascular system does not appear to differ from that of the other *Polycerinæ*,—the pericardium, ventricle, auricle, and portal heart exhibiting no peculiarity. The renal organ has not been observed.

* We have had an opportunity of examining the buccal organ of *Euplocamus croceus*, which differs from that of *Triopa claviger* in having a prehensile collar, and a much broader tongue, with very numerous plates; *three* of the inner ones on each side bear large blunt spines.

TRIOPA.

The ganglia of the nervous system resemble those of *Ægirus*. There are two pairs of œsophageal centres, the median and upper one being composed of two large oblong masses, placed close together, and united above the alimentary tube. These mases are formed by the fusion of the cerebroid and branchial ganglia. They distribute their nerves almost exactly as in *Ægirus*, and the olfactory nerves have at their origin each a considerable ganglionic enlargement. The pedial ganglia rest against the sides of the œsophagus, and are united below that tube by a short commissural cord,—the great œsophageal collar: they give three nerves to the foot. A visceral nerve comes off from a small ganglion, closely attached to the branchial portion of the right central mass.

The buccal ganglia are in close contact with each other; and are united to the upper or central masses by shorter cords than usual.

The eyes, which are of the usual character, receive their nerves from minute elliptical ganglia, attached to the external margins of the cerebroid portion of the central masses. The auditory capsules are situated at the junction of the same masses with the pedial ganglia, and appear to belong to the cerebroid portion of the former. They contain numerous elliptical otolithes.

The skin is much stiffened and crowded with spicula, which are large, strong, and generally bifurcated at one end.

Genus 4. ÆGIRUS,* Lovén.

Corpus robustum, gibbum, postice attenuatum, vix palliatum, tuberculis validis, prominentibus undique instructum. *Caput* inferius, subtentaculatum, maxillâ unicâ superiore. *Tentacula* 2 dorsalia, cylindrica, simplicia, intra vaginas retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes. Apertura genitalis ad latus dextrum.

Professor Lovén established this genus in 1844, in the 'Proceedings of the Royal Swedish Academy,' for a curious little mollusk, the *Polycera punctilucens* of D'Orbigny, at present the only known species. Its most striking characteristic is the large wart-like tubercles with which it is covered, but it differs from *Polycera*, and apparently from all the known genera of the *Doridideæ*, in having smooth, unlamellated tentacles; and instead of having two lateral jaws, as in several of the other Nudibranchs, it has a single dorsal one, a character in which it resembles the land slugs.

The body of *Ægirus* is stout and rather gibbous, tapering to an obtuse point behind. It is studded with large and prominent tubercles, which extend over the whole of the upper surface. There is no distinct cloak, but the rudimentary margin of one may be readily traced, projecting over the head in front, and running along the sides of the body to the branchial plumes. The head is inferior, and has on each side a flat tentacular appendage. There is only a single jaw, which forms an arched corneous plate on the upper side of the mouth. The two dorsal tentacles are linear and smooth, and are retractile within lobated sheaths. The branchiæ are plumose, surrounding the vent on the median line about one third down the back. They are protected anteriorly and laterally by large lobed tubercles. The foot is nearly linear, square in front, and obtusely pointed behind. The aperture of the sexual organs is on the right side.

In internal organisation, *Ægirus* resembles *Polycera* as closely as it does in external form: there are, however, some very interesting modifications of detail, particularly in respect to the buccal armature.

The mouth opens on the under surface of the head, and the channel leading to the buccal organ is very short. This latter organ is firm and muscular, but rather small: it is furnished with a single horny plate or jaw (Pl. 17, fig. 14 *d*, and fig. 15), situated in the buccal lip above, holding exactly the same position, and apparently acting in the same manner as the horny jaw or tooth of *Limax*. This is the only instance among the Nudibranchs in which we have detected an upper jaw. It is lamelliform, rounded above, and has the lower or cutting margin, which projects downwards, truncated, thickened, and produced into an obtuse point in the centre. The orifice of the buccal organ is guarded below by two lateral fimbriated membranes (fig. 14 *e*), angulated above. The tongue is broad, as in *Doris tuberculata*, having nineteen rows of amber-coloured, simple, compressed spines, thirty-eight or forty in

* From Ægir, the god of the Ocean, in northern mythology. Professor Lovén originally wrote the name of the genus *Ægires*, but in a more recent publication he has changed the termination to *us*, which we adopt as more consonant with classical usage.

each row: the median spine is deficient, and the tongue is divided down the centre by a narrow naked space. The tubular portion behind projects a little backwards from the buccal organ. A pair of tubular salivary glands open into the mouth at the sides of the œsophagus. This latter organ is rather short, and passes from the upper posterior end of the buccal mass: it is of equal caliber throughout, with the exception of a slight swelling immediately after it passes through the nervous collar: it enters the liver in front, to join the stomach, which is small, and buried in that viscus. A portion of the upper surface of the gastric pouch is seen, however, emerging upwards from the biliary organ, and gradually subsiding into the intestine, which is short. At the junction of this tube with the stomach, there is a small oval sac—a rudimentary pancreas—and at the other extremity, a gland-like body; but this latter does not appear to be connected with the alimentary tube, and we have not succeeded in determining its nature.

The reproductive organs are much like those of *Polycera*. The testis is composed of a tubular, and a large, irregularly rounded, glandular portion; the intermediate thin duct-like tube not being present. The spermathecæ are oval, the principal one being large, the other very small.

There is nothing peculiar in the vascular system, so far as we have been able to examine it, and the renal organ, though observed, has not been sufficiently made out.

The nervous system is more highly concentrated than in *Polycera*. There are only two pairs of principal œsophageal ganglia,—the cerebroid and branchial being completely fused, so as to form, above the alimentary tube, two large reniform masses, which are united to each other by a very short commissure across the median line. The anterior portions of these masses represent the cerebroids, and accordingly each gives off from the frontal margin three nerves, which supply the channel of the mouth and the oral tentacular appendages. The olfactory ganglia are large and oval, being equal in size to the buccal; they are closely adherent to the frontal margin of the same ganglia, but a little nearer to the median line. The nerves they supply are stout, and go direct to the dorsal tentacles. The posterior portions of the large central masses are the branchial ganglia, and from the outer margin of each a couple of nerves are sent off, which, branching forwards and backwards, go to the dorsal skin: the anterior branch supplies the veil or mantle-border overhanging the head. From the right branchial, two additional nerves are given off; one of which, coming from the outer margin, passes to the male sexual organ; the other is given off from the under side. These are all we have detected of the visceral nerves. The pedial ganglia are rounded in form, and are closely attached to the outer margin, below, of the two large central masses: they are placed at the sides of the œsophagus, and are united below that tube, by a rather long, stout cord,—the great œsophageal collar, composed, in this instance, of three filaments, two of which are, as usual, pedial—one branchial: three nerves are given by these ganglia to the foot.

The buccal ganglia present nothing unusual; they are joined together across the median line by a short commissure. The gastro-œsophageal ganglia have not been observed.

The eyes are sessile on the outer margin of the anterior or cerebroid portions of the central ganglionic masses. The auditory capsules are attached to the under side of the same portions immediately behind the eyes, and contain numerous elliptical otolithes, and a single spherical one, much larger than the others.

The skin is tough and coriaceous, having the imbedded spicula much more crowded than in any other of the *Polycerinæ*: they are fusiform, pointed at both ends, and bent in the centre.

Genus 5. THECACERA,* Fleming.

Corpus limaciforme, læve, non palliatum, postice acuminatum. *Caput* subinferius, velo aut plano aut lobato sepissimè obtectum. *Tentacula* 2 dorsalia, laminata, intra vaginas retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes, appendicibus lateralibus linearibus vel tubercularibus. Apertura genitalis ad latus dextrum.

Thecacera is very nearly allied to *Polycera*, from which it chiefly differs in having sheathed tentacles; the laminated character of these organs, together with the smooth surface of the body, sufficiently distinguish it from *Ægirus;* and with other genera of the group it cannot readily be confounded. The genus was proposed by Dr. Fleming in his 'History of British Animals' (1828) for the *Doris pennigera* of Montagu, a rare and curious Mollusk, then only known by the description of the latter author, and even up to the present time involved in much obscurity; but possessing characters, which, Dr. Fleming very properly observed, "mark it as the type of a genus." Another species has lately been discovered by Mr. Cocks at Falmouth; and more recently still, a third species has been dredged off St. Ives by Mr. Barlee. These agree with that of Montagu, in the smooth body, and laminated and sheathed tentacles, but vary in almost every other respect from the typical form.

The only known foreign species of this genus was found by Mr. Charles Darwin in the Chomos Archipelago, south of Chiloe, and is not yet published.

Thecacera has the body limaciform and smooth, swelling a little in the centre, and terminating in a pointed tail. The head is sub-inferior and furnished, like *Polycera*, with corneous jaws: it is generally covered by a velar expansion, more or less distinct, and of variable character, being either even, lobed, or tuberculated. The tentacles are two in number, dorsal, and laminated; retractile within even or foliated sheaths. There is no dorsal area or rudimentary cloak. The branchiæ are plumose, surrounding the vent in the centre of the back posteriorly. They are furnished with one or more appendages on each side, which in some species are large and well developed, in others tubercular and obscure. The foot is of the usual form, and co-extensive with the body. The aperture of the sexual organs is on the right side.

The anatomy of *Thecacera* appears to be very similar to that of *Polycera;* but on account of the rareness of the genus, we have not been able to examine it in detail. We have ascertained, however, some particulars respecting the buccal apparatus and the nervous system.

The buccal organ and jaws of *T. virescens* closely resemble those of *Polycera Lessonii*, the jaws having very imperfect cutting edges: in *T. capitata* the jaws are, however, more like those of *P. quadrilineata*. The tongue of the former species has eighteen or nineteen rows of

* From θήκη, a sheath, and κέρας, a horn.

plates, seven in a row on each side, and can be distinguished from that of *P. ocellata* only by the external plates, which are a little squarer and broader than in that species: the two spiniferous plates next the median line are perfectly alike in both these forms, and the tongue is divided down the centre by a naked space, in precisely the same manner.

The nervous system has three pairs of œsophageal ganglia, arranged as in *Polycera,* only the cerebroids are a little elongated in the antero-posterior direction, and the buccal ganglia are closely united together.

The nerves appear to be distributed as in that genus; the eye is provided with a lens and cornea, and is sessile on the cerebroid far forward on the outer border; the auditory capsules contain numerous otolithes, and seem to belong to the same ganglia.

The skin is fine and smooth;—the spicula have not been examined.

GENUS 6. POLYCERA,* CUVIER.

Corpus limaciforme, aut læve aut tuberculatum, postice acuminatum, vix palliatum. *Caput* subinferius, subtentaculatum, velo frontali mucronato vel tuberculato, in lineam dorsalem tuberculatam utrinque continuato; maxillis corneis. *Tentacula* 2 dorsalia, subclavata, laminata, non-retractilia. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes, appendicibus linearibus vel lobatis utrinque ornatæ. Apertura genitalis ad latus dextrum.

With great uniformity in general appearance, the *Polycerinæ* shew so many varieties in detail that it is difficult to avoid raising almost every species to generic rank. The genus *Polycera* was instituted by Cuvier, in the 'Règne Animal,' on the type of the *Doris quadrilineata* of Müller, a species of which, though reappearing from time to time under many different names—*cornuta, flava, lineata, varians,* and *typica*—still remains the only animal in which the *Polyceral* (many-horned) character of the frontal expansion is distinctly recognisable. Several other species have been included in the genus, nearly all of which have since been detached to constitute different genera, and the two which form our second section might without impropriety be raised to a similar rank, were it not that we are unwilling to multiply genera on slight characters. The most available characters for generic distribution in this sub-family are the tentacles—laminated or unlaminated—sheathed or unsheathed—with or without basal filaments. The appendages adorning the branchial region are also of importance; as well as the more or less distinct cloak, sometimes only indicated by a dorsal area circumscribed by a ridge of tubercles or filaments, and occasionally almost entirely wanting. Cuvier thought that the branchial lobes covered and protected the branchiæ in times of danger, but most of these appendages are but ill adapted for such a purpose.

Themisto of Oken is synonymous with *Polycera*. The range of the genus is rather uncertain, but it appears to extend throughout the European seas, and probably over most of the shores of the Atlantic. Five species have been found in Norway, two in France, and one in the Mediterranean. Of extra European species, one occurs in the Canary Islands, another on the coast of North America, and a third in Rio de Janeiro.

The body of *Polycera* is limaciform, smooth or tuberculated, swelling a little in the centre, and acuminated behind. The head is subinferior and has the sides a little lobed or dilated without forming true oral tentacles. The mouth is furnished with corneous jaws, a rare circumstance in the *Doridideæ*. The veil, as it is usually called, or, more properly, the frontal

* From πολύς, many, and κέρας, a horn.

margin of the rudimentary cloak is more or less dilated, bearing on the margin tubercles, digitations, or tentacular filaments. A ridge of tubercles, sometimes connected by a slight membrane, extends along each side of the back, from the margin of the veil to the branchiæ, terminating in one or more simple or lobed branchial appendages on each side. The tentacles, two in number, are dorsal, placed in the usual position; they are subclavate, laminated on the upper portion, and non-retractile; without sheaths or basal filaments. The branchiæ are plumose, and surround the vent about two thirds along the back, whence a central ridge extends to the tail. The foot is nearly linear. The aperture of the generative organs is simple, and placed on the right side.

The genus may be divided into two sections as follows:—

Section 1. Veil dilated into tentacular filaments; branchial appendages linear, one on each side. Type. *P. quadrilineata.*

Section 2. Veil short, bilobed and tuberculated: branchial appendages tubercular, more than one on each side. Type. *P. Lessonii.*

Polycera quadrilineata is generally found on *Fuci*, *P. Lessonii* on flexible zoophytes: the former is therefore probably herbivorous, the latter carnivorous.

There is not much diversity in the anatomy of the three British species of *Polycera*, though, in some respects, *P. quadrilineata* differs in its organisation from its congeners. The channel of the mouth is exceedingly short, leading almost immediately from the external opening, situated in the inferior surface of the head, into a rather large and powerful buccal organ, provided with corneous jaws, which (Pl. 17, fig. 11*b*) in the species of the second section are small, and of a sub-triangular form, with the cutting edge (*d*) feebly developed. In *P. quadrilineata*, they (fig. 10) are larger, and are pretty efficient cutting instruments, having their upper margins concave and bearing each in front a lengthened, well-arched, cutting blade (*a*). The tongue is moderately broad, generally of an amber colour, occasionally dark: the posterior portion is tubular, and protrudes a little behind the buccal organ. In *P. quadrilineata* there are fifteen rows of plates, with twelve plates in a row,—six on each side. Two on each side, next the median line, bear bicuspid spines; the innermost of these have the spines considerably smaller than the others: the external plates are of an elongated form, a little elevated in the centre, and diminish in size towards the external border. The tongue is divided down the centre by a naked space, the central plate being wanting. In the other two species, the lingual organ is similar to the above, but in them the spines are shorter and stouter, and the innermost are proportionally smaller. In *P. ocellata*, the rows of plates are sixteen in number, with seven in a row on each side: in *P. Lessonii* there are only thirteen rows, eight plates on each side, and the naked space down the centre of the tongue is of considerable width.

The œsophagus (fig. 9*c*) is a rather long, simple tube, and has at its origin on either side a small salivary gland, (*b*) which opens into the buccal organ (*a*): these glands are tubular and are more or less folliculated. The œsophagus, passing backwards, enters the anterior border of the liver on its way to the stomach, which is small, and is buried in that viscus, the upper wall (*d*) being visible at the surface above and towards the left side. Here the intestine (*e*) leaves the gastric pouch, and passing across the liver to the right, arrives at the anal termination (*f*) in the midst of the branchial circle. The intestinal tube is rather short, and in

P. Lessonii is a little dilated just before it terminates. A small oval sac, apparently the same as the pancreatic organ in *Doris*, opens into the stomach near to the œsophagus in *P. ocellata:* a similar organ probably exists in the other species, but has escaped observation. The liver (*g*) is of a brownish yellow colour, of an oval form, with the anterior extremity truncated; its secretion passes into the stomach through three or four openings.

The reproductive apparatus in *P. quadrilineata* is much like that of *Idalia*. The testis is divided into three portions; that (*i'*) next the intromittent organ (*h*) is moderately thick and tubular: the inner extremity of this portion is swelled a little, and is succeeded by an attenuated tube (*i''*) having a duct-like appearance, which leads to one end of a large, irregularly oval, glandular organ (*i*), presenting the semblance of a laminated structure; the other extremity of this portion is united by a short tube (*i'''*) to the oviduct. The ovary is spread out as usual over the liver, and the oviduct is at first slender, (*j*) and afterwards much dilated (*j'*) as it reaches the testis. The vaginal tube (*l*) is rather long and slender; it opens into the obtuse end of a very large pyriform spermatheca (*m*). A long, delicate duct (*n*), passes from the same point to the oviduct, and has attached to it a small oval sac—a second spermatheca (*o*). The mucus-gland (*k*) is much convoluted.

The generative organs, in *P. ocellata* and *P. Lessonii* are similar to those of *P. quadrilineata*, differing only in unimportant modifications. In the former, the glandular portion of the testis is smaller and fusiform, as in *Goniodoris*, and the principal spermatheca is roundish and much diminished in size.

The vascular system is apparently as highly developed in *Polycera* as in any of the *Doridideæ*. The heart is contained within a pericardium, and is composed of a ventricle (*p*) and an auricle; the latter receiving the blood from the gills and skin, the former distributing it again by a large artery from the anterior apex in the usual manner. The portal heart lies below the pericardium, and is rather small. In *P. quadrilineata* there is a folliculated glandular organ in connexion with the arterial system, lying on the right side in front of the reproductive organs. This is similar to what has been observed in *Idalia* and *Ancula*, and will probably be found in all the *Polycerinæ*. The heart beats sixty-two times in a minute in *P. Lessonii*; in *P. ocellata*, from seventy-two to eighty-eight times; and in *P. quadrilineata* from ninety to a hundred times.

The renal organ is distinctly visible in *P. Lessonii*, and is copiously supplied with vessels; the margins have a dendritic appearance, and the external orifice is placed to the right in front of the anus. In the other species this organ has been less perfectly observed.

The nervous system is provided with three pairs of œsophageal ganglia, besides the accessory ones. They may all be considered as placed above the alimentary tube, though the pedials droop a little on its sides. In *P. quadrilineata*, the cerebroids (fig. 12, *a, a*) are irregularly quadrilateral, inclined to pyriform, with the broad ends united across the median line. They give off from the frontal margin three pairs of nerves, (2, 3, 4), which go to the lips, the oral appendages, and channel of the mouth. The olfactory nerves (1) pass from the upper surface of the anterior margin, and have each at their origin a small round ganglion, and another (*j*), which is considerably larger, is connected with them as they reach the laminated portion of the tentacles: from the latter, several nerves pass up the tentacles. The branchial ganglia (*b, b*) are round, and closely adherent to the posterior extremity of the cerebroids: they give off each two nerves, one (7) of which goes to the skin of the back, and

the other (6), passing forward, supplies the same in front, and also the tentacular filaments. The right branchial gives off from the under surface an additional nerve in connexion with the branchial collar, which shortly enlarges into a small round ganglion—the visceral (*e*): this sends two or three nerves (17, 18) to the viscera. The left branchial ganglion also gives off in connexion with the collar another visceral nerve (16). The pedial ganglia (*c, c*) are of an oval form, and are placed at the outer margins of the branchial, to which, and to the cerebroid, they are attached by very short commissures. They each give three nerves (9, 10, 11) to the foot, and the left ganglion a small one (8) to the side of the body. A similar nerve has not been observed on the right side, though it probably exists. These ganglia are united below the œsophagus by a long collar or commissure, (*i*) which is composed of two filaments. The branchial are likewise united below the alimentary tube; the cord (*h*), which is fine, leaving the ganglia in connexion with the origin of the visceral nerves. These two commissures run across in union with each other, forming, as it were, but one great œsophageal collar.

The buccal ganglia (*f*) are of an oval form; they are united across the median line by a distinct commissure, and to the cerebroids by long, slender cords (*g, g*). These ganglia give nerves in the usual way to the buccal organ, tongue, and œsophagus. The gastro-œsophageal ganglia have been observed only in *P. ocellata.*

P. Lessonii and *P. ocellata* exhibit no material modification in the nervous system: the cerebroids, however, are more rounded in the latter; and in the former are broad in front and pointed backwards, approximating in form to those of *Doris tuberculata.* The right branchial, too, of both species gives off a nerve in front, which goes to the male generative organ. There can be little doubt of the existence of a similar nerve in *P. quadrilineata,* but it has hitherto escaped observation. The visceral ganglion has not been noticed in *P. Lessonii.*

The eyes are rather large, and are as completely organised as in *Doris;* in *P. quadrilineata* they are each supplied with a short optic nerve (5) arising from a minute elliptical ganglion appended to the outer margin of the cerebroids. The auditory capsules contain numerous otolithes, and are attached to the under side of the outer margin of the same ganglia immediately behind the eyes. These have been examined only in *P. Lessonii.*

Vibratile cilia cover the whole surface of the body, including the tubercles, as well as the tentacles, gills, and branchial processes.

The skin is comparatively thin and delicate, having a few soft tubercles on the surface. The imbedded spicula are rather sparingly scattered; they are stout, linear, and generally tuberculated, and bent a little in the centre.

Genus 7. ANCULA,* Lovén.

Corpus elongatum, gracile, læve, non palliatum. *Caput* terminale, subinferius, utrinque in papillam brevem tentaculiformem productum. *Tentacula dorsalia* 2, subclavata, laminata, non-retractilia, basi stylis instructa. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum circumdantes; cirris linearibus, subclavatis, utrinque ornatæ. Apertura genitalis ad latus dextrum.

Like others of the *Polycerinæ*, this genus is founded on a single species, and we may therefore refer to the account of that species itself for some part of its history. *Ancula* was established by Professor Lovén in his excellent little 'Index Molluscorum Scandinaviæ,' published in 1846. The species was first described by one of the authors of this work in 1841.† We have recently learned, however, that this beautiful little mollusk had been discovered by Dr. Fleming so long ago as 1814, having ascertained from a sketch kindly sent us by that distinguished naturalist, that the animal referred to in his 'British Animals,' page 283, is no other than the *Ancula cristata*.

The genus differs from *Polycera* in having basal filaments to the tentacles, and in the absence of a velar expansion and dorsal area. These latter circumstances likewise separate it from *Idalia*, with which, in most of its characters, it very nearly agrees; though its general habit, and more slender and graceful form, serve at first sight to distinguish it. The single representative of this genus appears to be generally diffused throughout the seas of Northern Europe, and is plentiful on many parts of the British coast. We have not heard of its occurrence in more southern latitudes. It is probably carnivorous, as it is never found on seaweeds, but is most plentiful on stones, associated with minute zoophytes.

Ancula has the body elongated, slender, and smooth, terminating in a point behind. There is no indication of a cloak, with the exception of a slight ridge in the vicinity of the gills, on which the branchial appendages are placed. The head is terminal, and without veil, having its sides produced into two short tentacular processes. The mouth is not provided with corneous jaws, but has a spinous prehensile collar. There are two subclavate, strongly laminated dorsal tentacles, without sheaths and non-retractile; near the base they are each furnished with two styliform appendages. The branchiæ are plumose, placed round the vent, on the most elevated part of the back, on the central line; they are surrounded by numerous linear or subclavate processes. The foot is slender and nearly linear. The common aperture of the genital organs is placed pretty far forward on the right side.

Any description of the anatomy of so minute and delicate an animal as *Ancula* must necessarily be imperfect; we have, however, possessed the advantage of having had at our command a large supply of specimens, and being thus fortunate, we have succeeded in

* *Ancula*, a maid servant. † Ann. Nat. Hist., v. 6, p. 340.

determining most points of importance, and in ascertaining that the internal structure bears out its relationship to *Idalia* on the one hand, and to *Polycera* on the other.

The oral channel is very short; it opens externally on the inferior surface of the head, and leads to a buccal organ, which is well developed, compact, and muscular, though of no great size; and has connected with its upper surface a gizzard, constructed in the same manner as in *Idalia* and *Goniodoris*. The tongue is long and narrow, having from twenty-five to twenty-seven rows of spines; there are four spines in each row, those next the median line being large, excessively broad, and flat, with their inner margins denticulated; the external spines are much smaller and plain; there is no central spine. The posterior portion of the tongue is tubular, and protrudes a little from behind the buccal organ in a sheath. The buccal lip is provided with a very formidable, spinous prehensile collar, (Pl. 17, fig. 7), which is wide, and, narrowing upwards, terminates on each side of the median line in a sharpish point. The spines, (fig. 8) are arranged in indistinct transverse rows; they are simple, curved, and much larger than is usual in the Nudibranchs.

The œsophagus is very long and slender: it has on each side, as it passes from the buccal organ, a small, oval, salivary gland, which pours its secretion into the mouth through a very short duct. At its origin, the œsophagus is swelled out into a crop, with delicate walls; it then suddenly contracts, and in the form of a constricted tube, passes through the nervous ring; immediately afterwards it again dilates a little for a short distance backwards, and contracting once more, is continued as a simple tube to the anterior border of the liver, into which it plunges on its way to the stomach. This latter viscus is small, and is buried just within the frontal margin of the hepatic organ. The intestine is given off from its upper surface, and, passing up through the liver, crosses over to the right side in front of the heart, and, after a short course, terminates in the anal nipple, within the branchial circle. There is a glandular enlargement of the intestinal tube just after it emerges from the liver, which is apparently the same as that which has been designated a rudimentary pancreas in *Doris*. The liver, of a yellowish brown colour, is rounded behind and truncated in front, and passes backwards beyond the branchiæ; the anus being situated comparatively further forward than usual.

The reproductive organs resemble, in the arrangement of their parts, those of *Goniodoris*, and the other *Polycerinæ*. The three component parts of the testis are not very distinctly marked; the glandular or fusiform portion exceeding the tubular only a little in caliber. The vaginal tube and spermathecæ are small.

A delicate pericardium contains a ventricle and an auricle, and below it is the portal heart. The ventricle gives off in front, in the usual manner, a large artery, which branches to the various organs; and there is a folliculated glandular body, overlying the genitalia, which is apparently connected with the arterial system, and is probably similar to that described in *Doris*, as situated in the vicinity of the œsophageal ganglia.

The branchial leaflets exhibit, in a high state of development, that curious internal structure, which in *Doris* we consider as an elastic apparatus to aid respiration by keeping the gills, to some extent, in a state of expansion when out of water; and such an apparatus would seem of peculiar advantage to *Ancula cristata*, as it lives between tide-marks, and is liable to be left dry by the receding tide. In this species, the apparatus in question is formed of a double row of roundish vesicles, set on a central stem, and is situated in the trunk and prin-

cipal branches of the leaflet, appearing in these parts as a double row of white dots. The walls of the vesicles are firm, and undoubtedly possess some degree of resiliency.

The œsophageal ganglia are not so much concentrated as in *Idalia*, in this respect agreeing with *Polycera*. In *Ancula* there are six principal ganglia, in three pairs. The cerebroids are placed above the alimentary tube, and are broadly fusiform, with their apices united across the median line. These supply nerves to the channel of the mouth, the lips, and dorsal tentacles; the channel and labial nerves are three in number; the olfactory or tentacular have each a small round ganglion at the origin, and from the root of these latter nerves there is also a minute twig given off, which goes apparently to the tentacular filaments at the base of the dorsal tentacles. The branchial ganglia are spherical, and are cemented to the under side of the cerebroids; they are placed at the sides of the œsophagus, and give off each a large nerve from behind, which supplies the dorsal skin. The right branchial also supplies, from the anterior margin, a nerve which goes to the root of the penis, and there joins a minute ganglion from which three or four small twigs are given to the intromittent organ. The pedial ganglia are situated below the alimentary tube, and are of the size and form of the branchial; they are closely united to the other two pairs above, and to each other below; thus completing a constricted collar of ganglia round that tube; they send three or four nerves to the foot. A small visceral ganglion is attached to the right branchial, at its junction with the pedial. Two or three nerves issue from it, which will, there can be no doubt, go to the viscera; but, from the minuteness of the species, we have failed to trace them. A delicate cord likewise passes from this ganglion, and, going to the branchial of the opposite side, forms the branchial collar.

There is nothing peculiar in the buccal ganglia, except that the commissure which unites them across the median line is rather long. The gastro-œsophageal ganglia have not been observed.

The eyes have the usual development; they are seated each on a minute round ganglion, which is sessile on the outer margin of the cerebroids. The auditory capsules contain numerous otolithes, but we have not succeeded in determining to which ganglia they belong.

Vibratile cilia appear to clothe the whole surface of the animal; they have been detected along the margin of the foot, and ridge of the back, on the gills and lateral papillæ, on the dorsal and oral tentacles, and on the tentacular processes.

The skin is smooth, soft, and delicate, with scattered imbedded spicula of a cylindrical form, bent in the centre and a little enlarged at the ends.

Genus 8. IDALIA,* Leuckart.

Corpus ovatum, crassum, anticè declive, posticè acuminatum, vix palliatum. *Caput* subinferius, subincrassatum, non tentaculatum. *Tentacula* 2 dorsalia, linearia, lamellata, non-retractilia. Area dorsalis cirris marginata. *Branchiæ* plumosæ, in lineâ mediâ dorsi anum cingentes. Apertura genitalis ad latus dextrum.

Idalia is a well-marked genus, characterised by Leuckart in 1828, in a small publication entitled 'Breves Animalium quorundam maxima ex parte marinorum Descriptiones.'†

The genus is distinguished from *Triopa* and *Euplocamus*, with which Dr. Philippi has confounded it, by its less destinct cloak, which forms a small dorsal area, not extending beyond the tentacles in front, and leaving a considerable space between it and the frontal margin of the head: the tentacles too are without sheaths, and the filaments which adorn the pallial margin are generally very long in front of them. These characters likewise distinguish it from the other allied genera.

The prevailing colour in *Idalia* is red. Its range appears to be pretty extensive, and, though nowhere common, members of the genus are found in most of the European seas. They chiefly live in deep water, and hence, perhaps, the infrequency of their occurrence. They are carnivorous.

The body in this genus is ovate, thick, and a good deal elevated on the central area of the back, from which it slopes down on all sides, especially in the frontal region, which is large and incrassated. The head is indistinct, broad, and subinferior, with a slight expanded margin above. There are no oral tentacles. The two dorsal tentacles are generally slender and linear: they are laminated,—sometimes only slightly and on the posterior side. The base of each is adorned with one or two filaments, which have sometimes been taken for additional tentacles. These are not attached to the tentacles themselves, as in *Ancula*, but to a thin and rather inconspicuous membrane—the margin of the rudimentary cloak—that circumscribes the dorsal area, passing close to the base of the tentacles in front, and running along each side of the back to the branchiæ. This margin is more or less fringed with filaments; the inclosed area has also frequently one or more rows of filaments. The branchiæ are plumose, and surround the vent on the posterior dorsal line: behind these a ridge runs down to the tail. The foot is broad, thick, and rounded in front. The aperture of the generative system is on the right side.

Idalia may be divided into two sections, differing from each other in the armature of the month, as well as in the following external character.

Section 1. Centre of the back with filaments. Type, *I. elegans*.

Section 2. Centre of the back without filaments. Type, *I. aspersa*.

Our observations on the internal organisation of this genus will have to be confined to that of *I. Leachii*, as this is the only species we have had the advantage of dissecting, and we are not aware that any description of the anatomy of the other forms has been published. We have, however, examined the lingual apparatus of four or five kinds.

* A name of Venus, from Mount Idalium, in the Isle of Cyprus, sacred to that goddess.

† We are indebted, for a copy of this publication, to Dr. Rüppell, of Frankfort.

IDALIA.

From the external characters, it is evident that *Idalia* and *Goniodoris* are closely related to each other; but the intimacy of their connexion is only made manifest by the study of their anatomy.

The mouth of *Idalia* opens almost at once into a buccal organ, which is rather small, and is provided with a muscular gizzard attached to the upper surface, and a pair of short tubular, salivary glands, with their extremities enlarged and folliculated. The tongue of *I. Leachii* is narrow, of a brown-amber colour, and formed of numerous rows of spines, four in each row; those next the centre being large and minutely denticulated at the sides; the external ones are simple and rudimentary: there is no central spine. The buccal lip is armed with a prehensile collar, not interrupted above, and having the surface covered with numerous minute simple spines.

In *Idalia elegans* the large lingual spines are similar in form to those of *I. Leachii*, but have the sides smooth. In *I. aspersa* and *I. pulchella*, belonging to the second section, these spines are broader, stouter, and more hooked, with the margins strongly denticulated; and moreover the prehensile collar (fig. 5 *a*), in these two latter species, is very imperfect, being composed of two rounded, minutely-spinous lobes, one on each side of the median line on the lower portion of the buccal lip.

The œsophagus is a long slender tube without dilatation: it opens from below into the stomach, which is small, and placed in a cleft in the anterior margin of the liver. The intestine proceeds from above, and passes backwards along the right side of the liver: towards its termination it is considerably enlarged. The liver is bulky and of an irregular oval form.

The reproductive apparatus differs only very slightly from that of *Goniodoris*. The testis is composed of three portions, but here the gland-like part cannot be called fusiform, but is irregular in shape and very large. The vaginal tube, though not so long as in *Goniodoris nodosa*, is very wide, and tapers as it approaches the spermathecæ, of which there are two; one being much larger than the other: both are elliptical. The ovary is spread over the upper surface of the liver, and the anterior surface of the oviduct is much dilated.

The auricle and ventricle are placed within a distinct pericardium, below which is the portal heart; and in every respect the circulation and respiration are exactly in the same condition as in *Goniodoris*. The renal organ has been only imperfectly observed, but the external orifice is conspicuous enough in front and a little to the right of the anal nipple. A glandular organ of a folliculated structure is in connexion with the arterial system in front of the generative apparatus.

The nervous system presents the same high degree of concentration observed in *Goniodoris;* there being four principal œsophageal ganglia; but the upper pair in *Idalia* are bilobed, indicating the position of the cerebroid and branchial, of which they are composed. The eyes are sessile on the outer margin of the cerebroids; the auditory capsules have not been observed, neither have the olfactory ganglia. The nerves are distributed much in the same manner as in *Goniodoris*.

The skin is smooth and soft, with imbedded spicula, which, in *I. aspersa*, are not crowded; they are fusiform, tuberculated, and bent in the centre. Cilia were detected on the tentacles and branchiæ, but nowhere else.

Alder, Joshua

A monograph of the British nudibranchiate mollusca with figures of all the species

Bd.: 6

London 1852